

# Navigating Dynamic Databases

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## Introduction

# Purpose

This document introduces several issues related to the problem of navigating multi-dimensional data spaces—large databases.

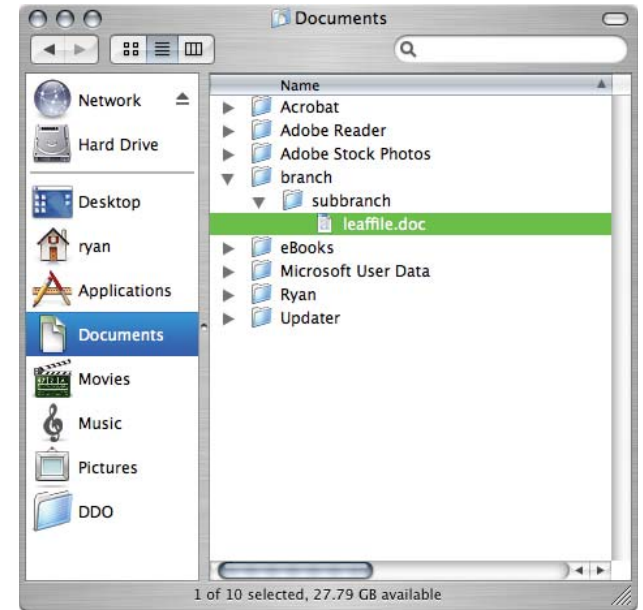
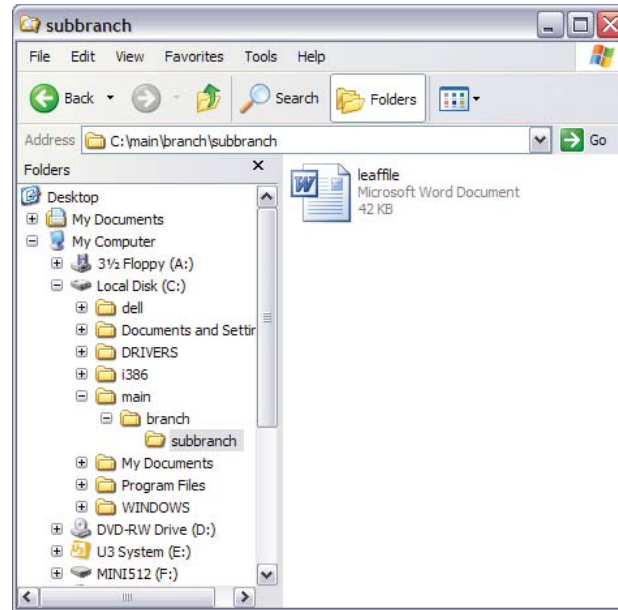
It examines problems with trying to conform data to a single taxonomy and the limits of tree structures as navigational devices.

It offers several alternative devices, and it notes the need to enable random, multi-variate filtering so that users may narrow and expand at will. It also introduces the concept of pivoting: narrowing along one path and turning (or pivoting) to expand along another path.

# Context

Over the past 25 years we have come to expect digital information to be organized in hierarchies. File systems are tree structures:

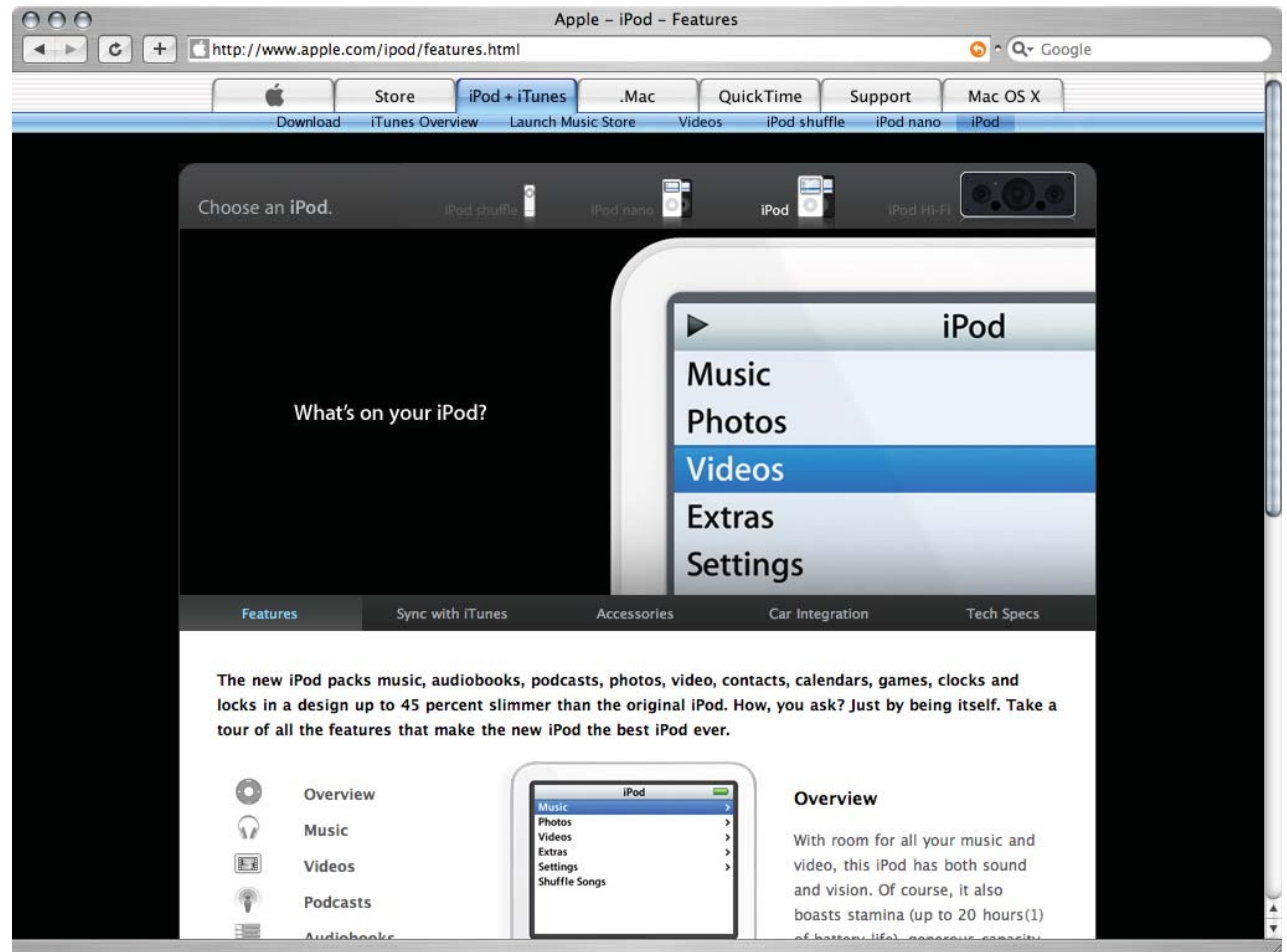
<C:\main\branch\subbranch\leaffile.doc>



# Context

The web, built on top of networked file systems, reinforced this form of navigation:

<http://www.apple.com/ipod/features.html>



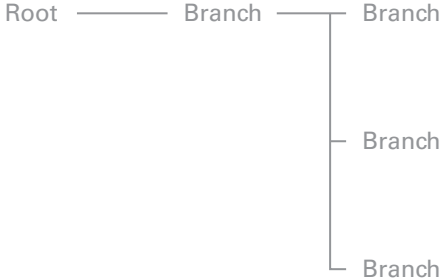
# Introduction to Tree Structures

Tree structures begin with a root.

Root

# Introduction to Tree Structures

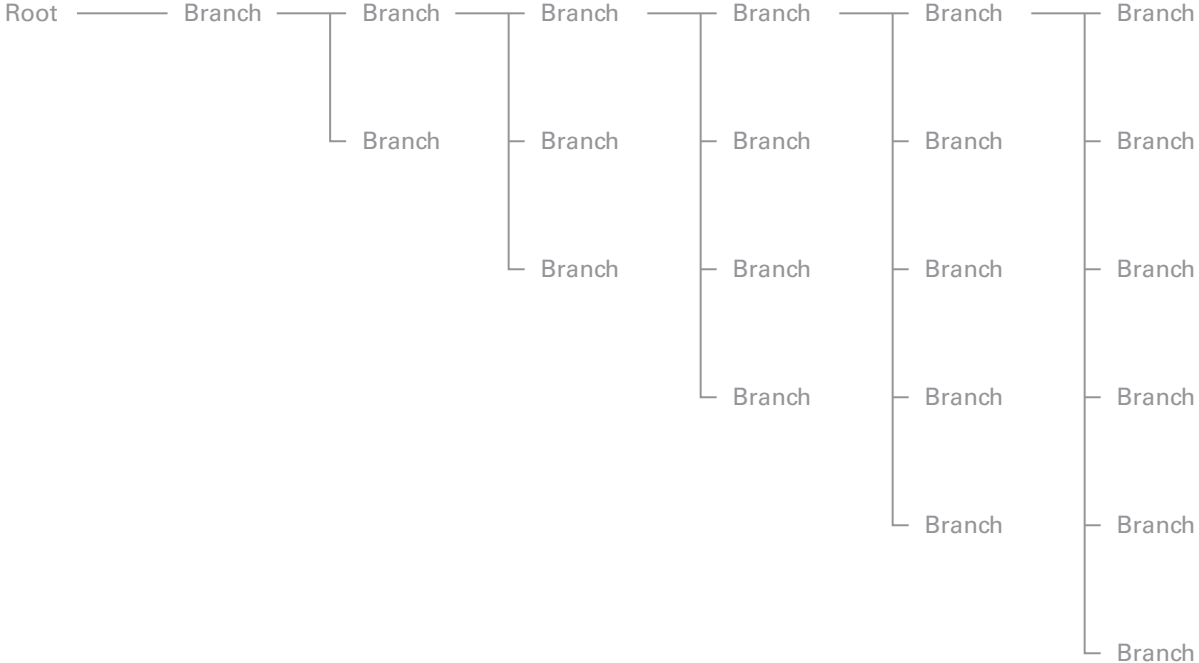
They also have branches.





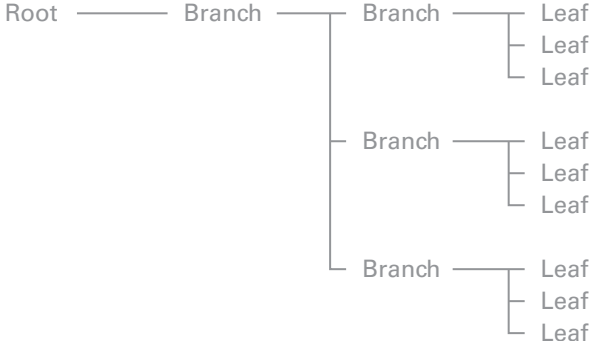
# Introduction to Tree Structures

Imagine this process repeated. A tree can be as deep (or tall) as you want. For our purposes, we will restrict our tree to only three levels.



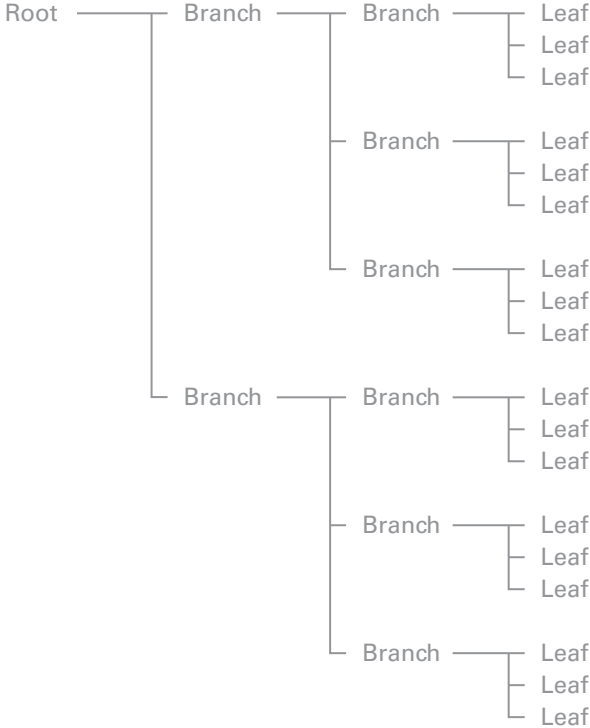
# Introduction to Tree Structures

At the end of the branches are leaves.



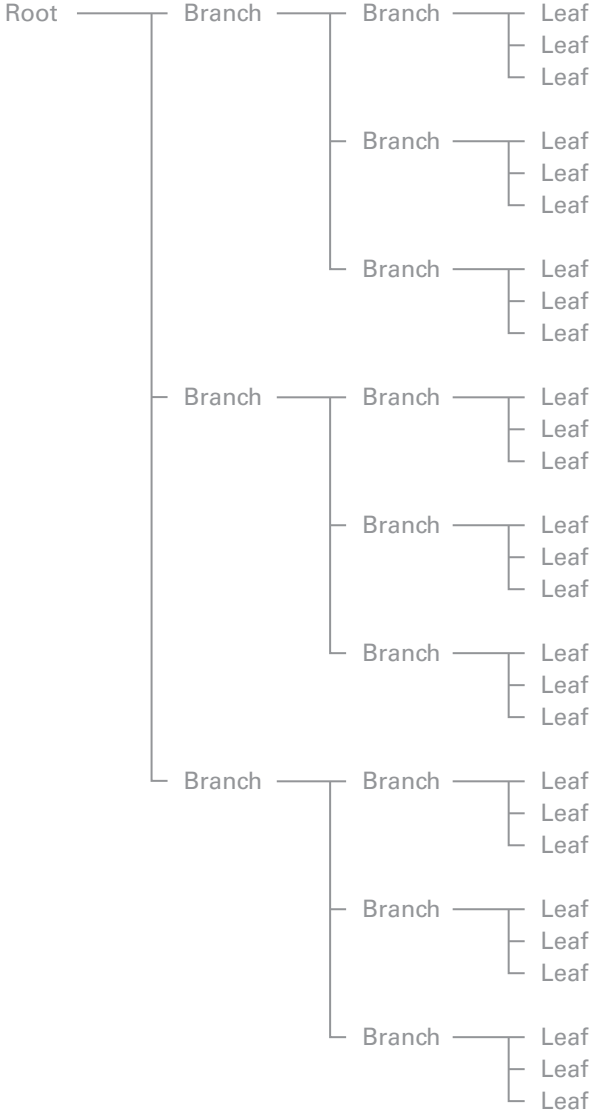
# Introduction to Tree Structures

Imagine this process repeated any number of times.



# Introduction to Tree Structures

As wide (or broad) as you want.



## Limitations of Tree Structures

Earlier, we saw that trees can be arbitrarily deep or wide. In practice, human perception has limits. Faced with many choices we may have difficulty comprehending them all. For example, many items at the same level in a menu may be difficult to parse.

George Miller's famous paper, *The Magic Number 7, Plus or Minus 2: Limits on Our Capacity for Processing Information* and research on short-term memory suggest a rule-of-thumb for designers. It may be best to limit the number of choices in a list to 7. If you have more than 7, it may be time to create groups—to nest categories.

That suggests the following corollaries:

- No more than 7 tabs
- No more than 7 main sections in a web site
- No more than 7 main menu items
- No more than 7 items in between "spacers" in a menu.

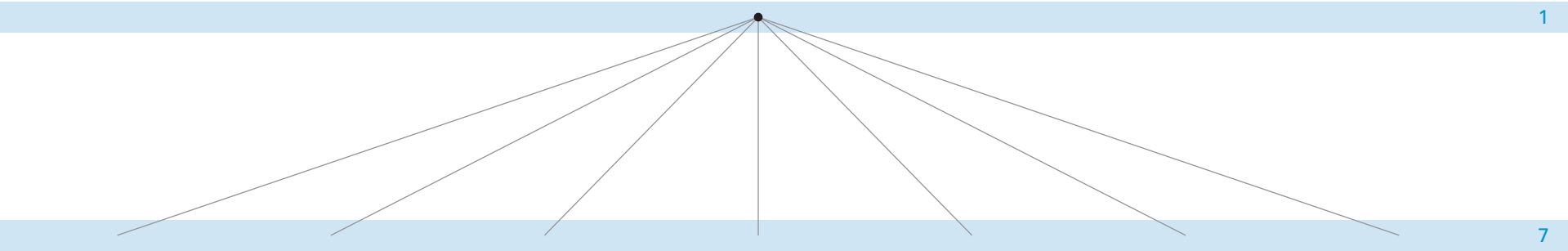
# Limitations of Tree Structures

The rule of seven has other consequences for site design. Imagine a root, a home page.



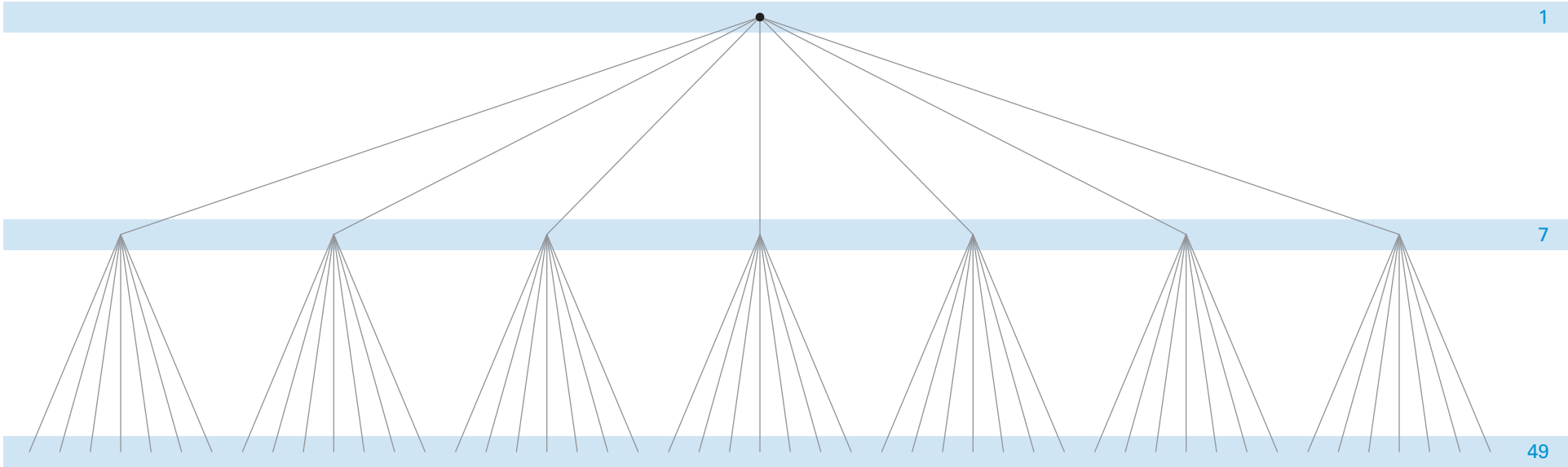
# Limitations of Tree Structures

The site has seven main sections.  
The second level of the tree has seven navigation paths.



# Limitations of Tree Structures

If each section has seven sub-sections, then the third level has 49 navigation paths.



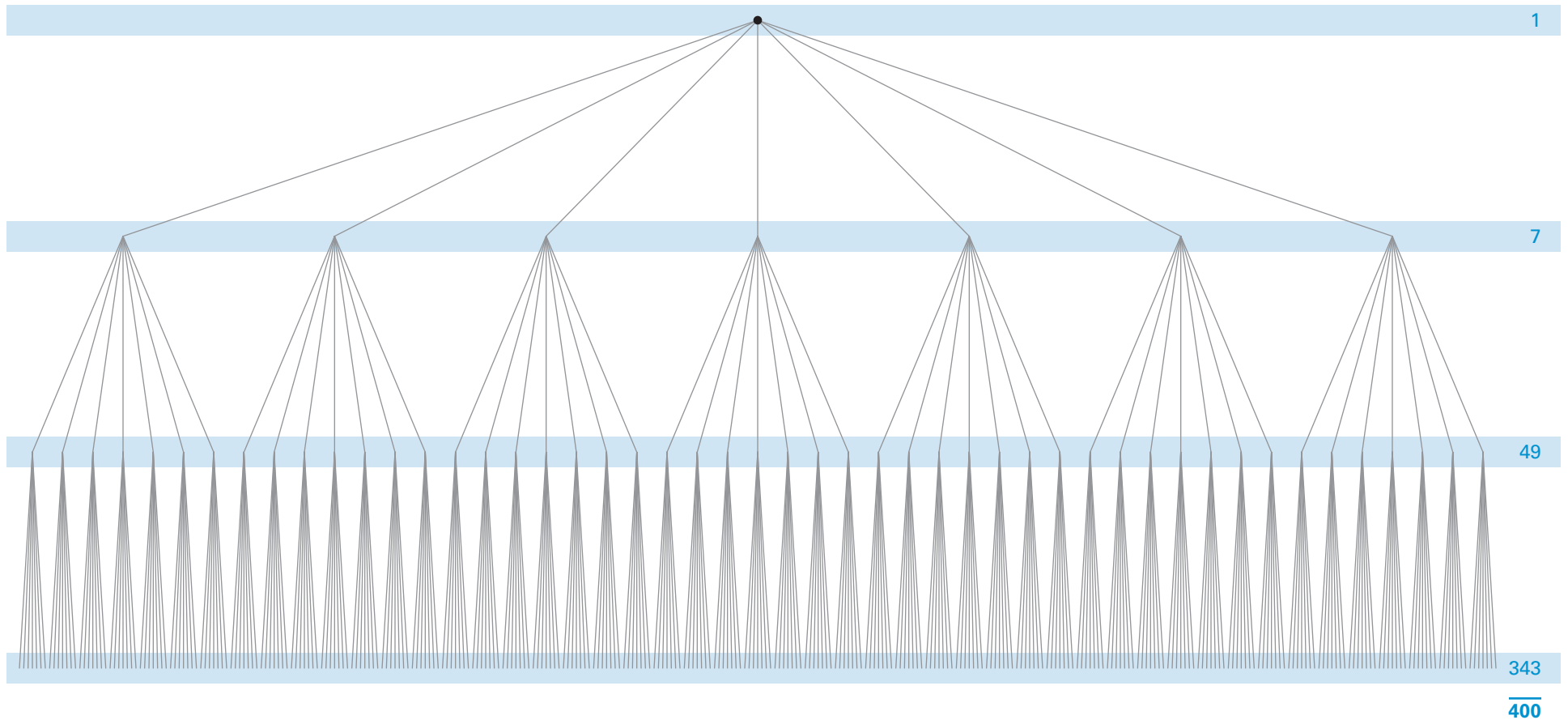


# Limitations of Tree Structures

If each sub-section has seven pages, the site has 343 navigation paths.

Add up the series:  $1 + 7 + 49 + 343 = 400$ . A conveniently 'round' number. As a rule-of-thumb, it provides a loose distinction between small and large sites. We contend tree-based navigation systems begin to fail on sites much larger than 400 categories.

Large sites, larger data collections, need other navigation structures, such as searching and filtering.



# Wine Tree

Let's look at an example. Say, for instance, that we have a collection of wine, and that we organize it by Color, Region, and Price.

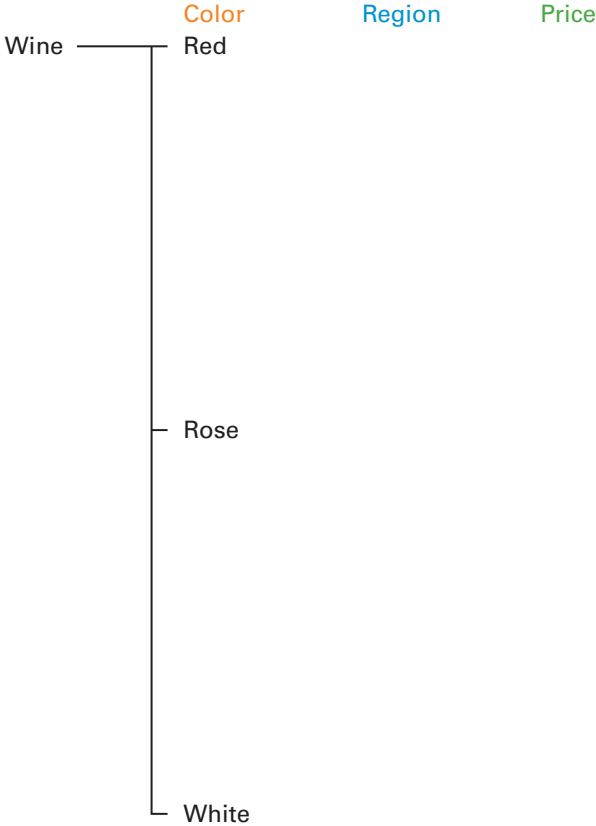
A database could be of anything. It could be cars, for example, organized by Year, Type, and Make. It could be poems . . .



# Wine Tree

Each category has its own sub-categories:

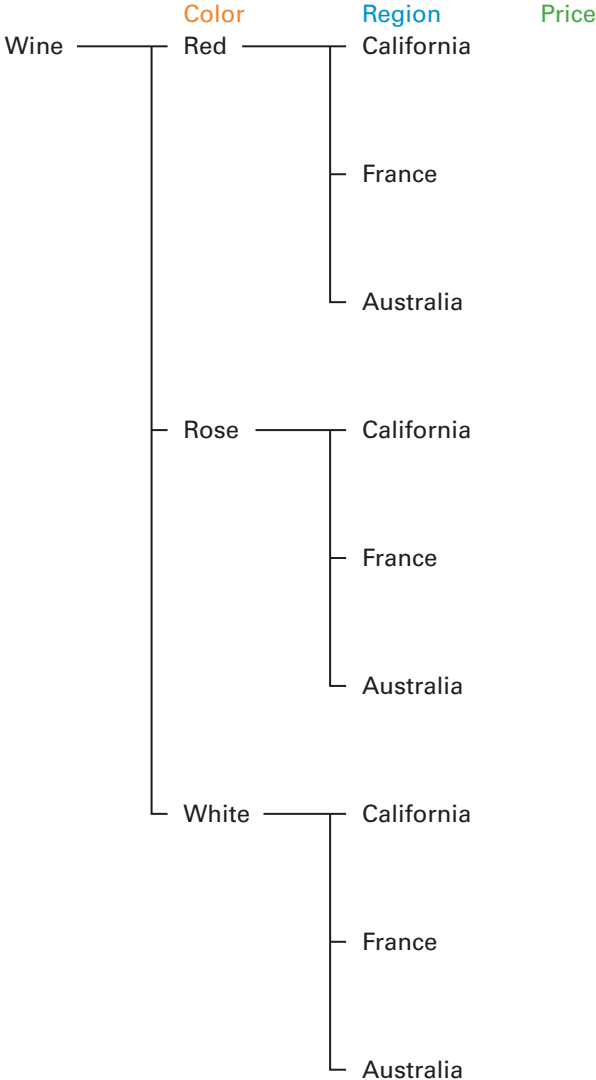
Color has Red, Rose, and White.



# Wine Tree

Each category has its own sub-categories:

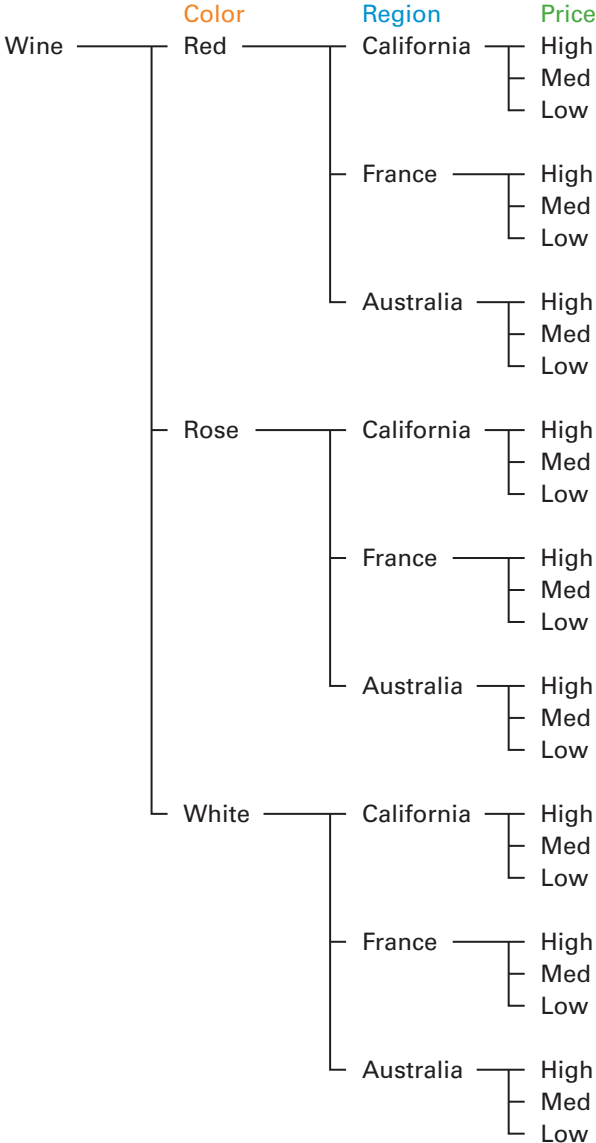
Region has California, France, and Australia.



# Wine Tree

Each category has its own sub-categories:

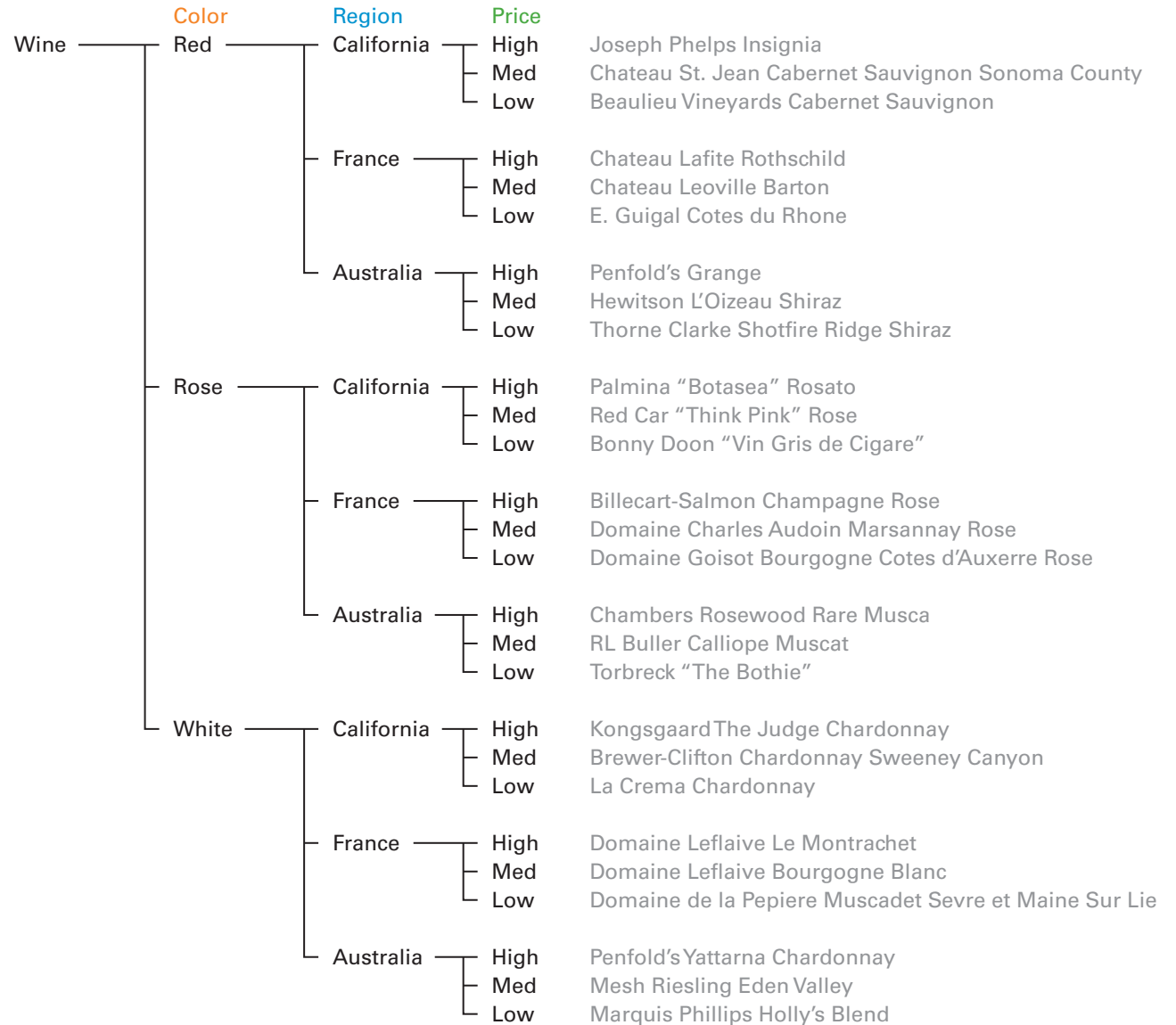
Price has High, Medium, and Low.



# Wine Tree

In our example, the final result is a single bottle of wine that matches each of the categories.

In a wine store, each category might have multiple bottles, e.g., from several vineyards and multiple years. Of course, vineyard and years are fourth and fifth dimensions. Variety of grape is another dimension. We're keeping things simple for our illustration.



## Wine Tree Combinations

When we created our directory tree, we randomly started with Color, then chose Region, and finally Price. That order might make sense if we're beginning our search with a goal of matching a wine to a food. However, we may want to begin with price or even region. The point is: No single taxonomy (tree structure) is best. Taxonomies are useful within a context—for a particular user, with a particular goal, at a particular time.

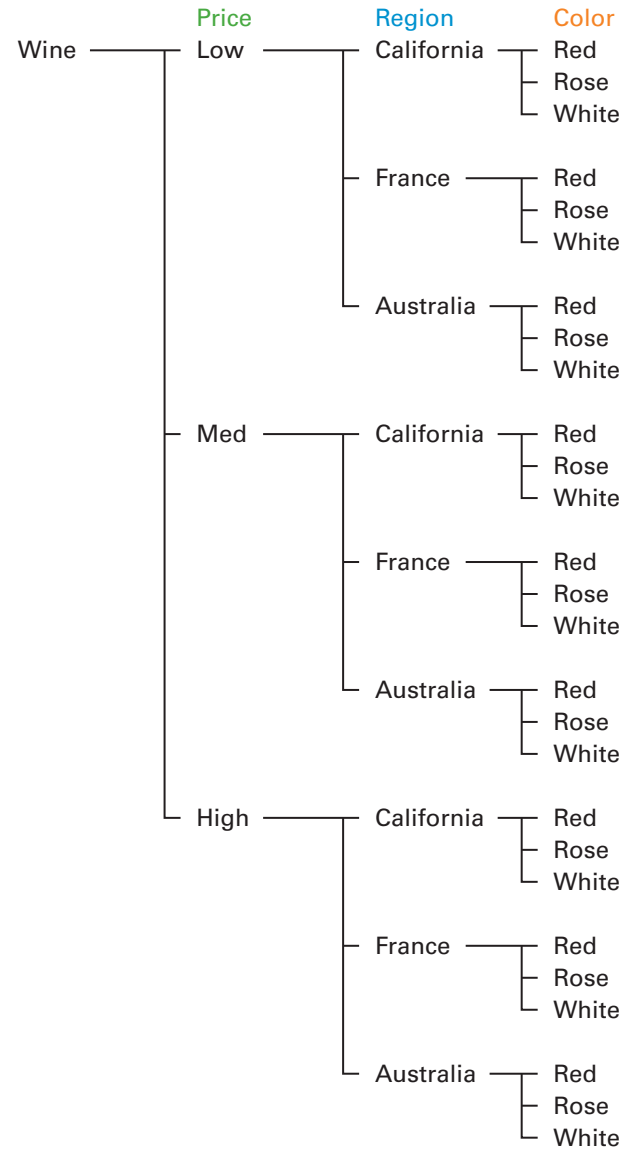
This set of information can be ordered in six ways (three unique elements in three positions yield six combinations).

1. ABC Price Region Color
2. ACB Price Color Region
3. BCA Region Color Price
4. BAC Region Price Color
5. CBA Color Region Price
6. CAB Color Price Region

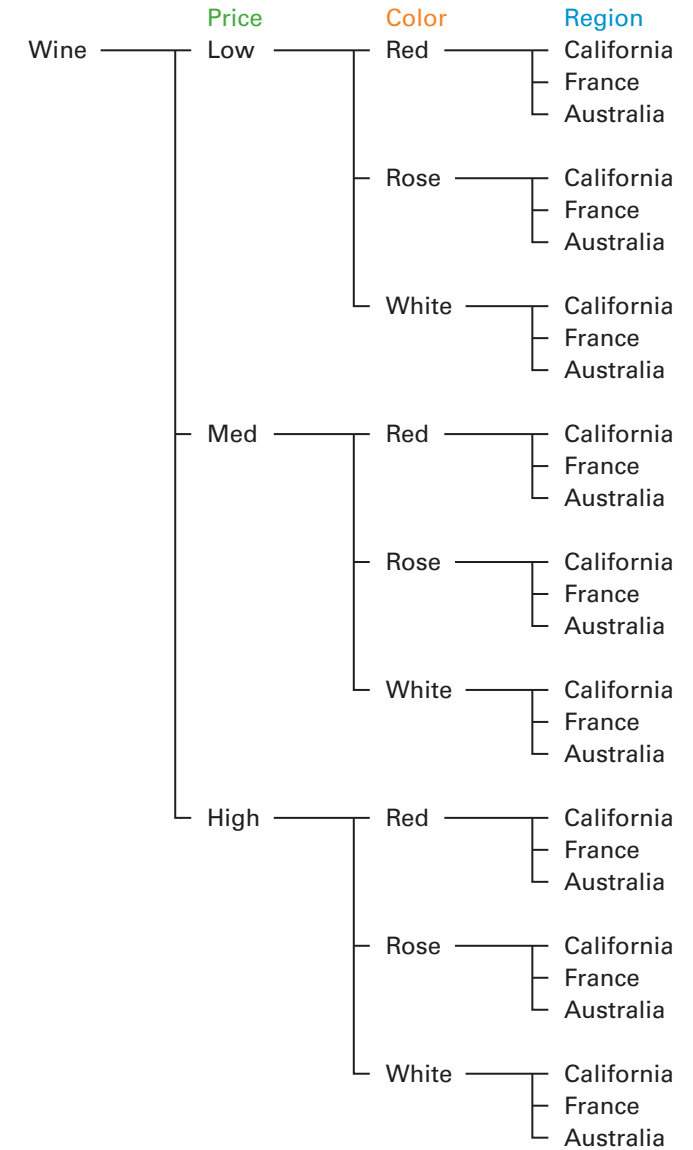
Real data is often much richer, allowing even more combinations.

# Wine Tree Combinations

1. Price, Region, Color



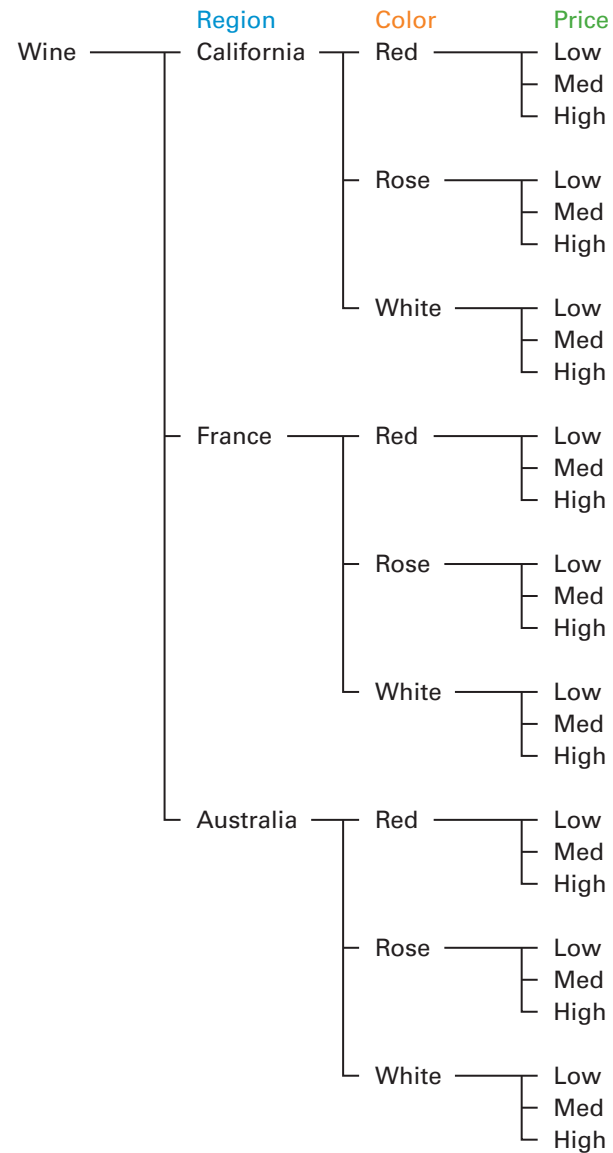
2. Price, Color, Region



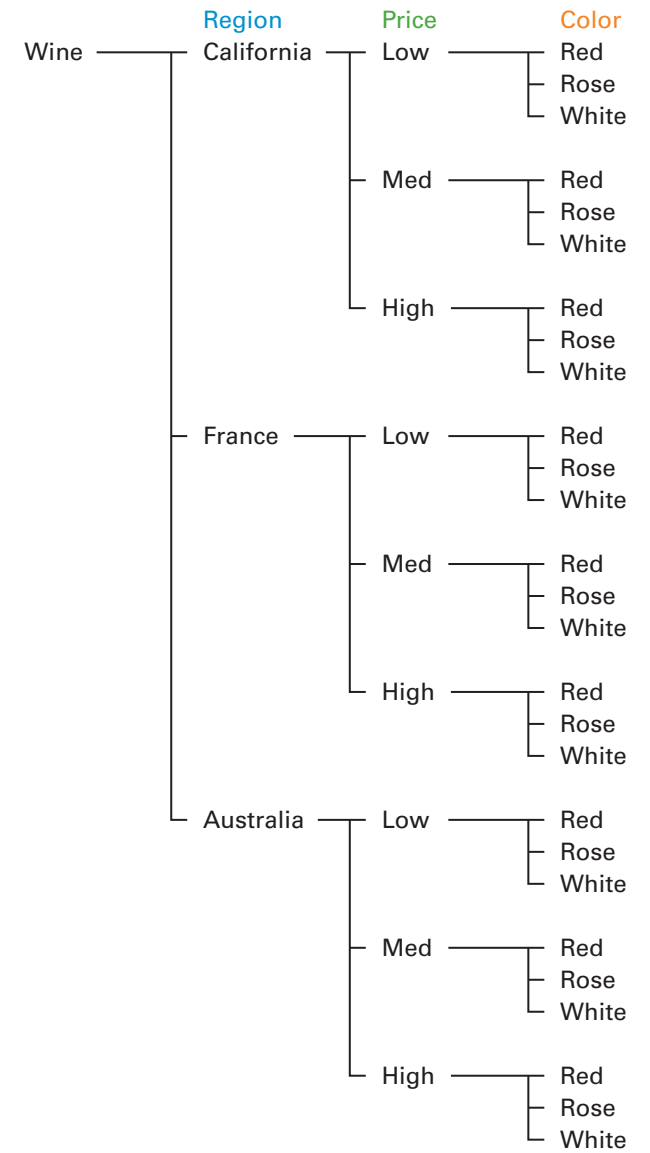


# Wine Tree Combinations

### 3. Region, Color, Price

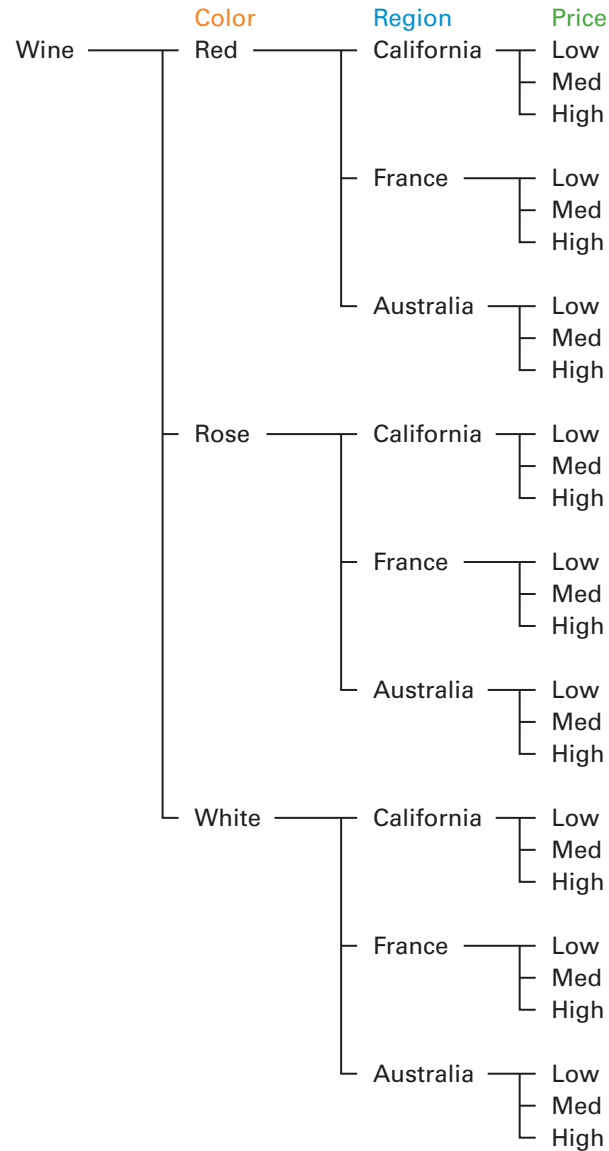


### 4. Region, Price, Color

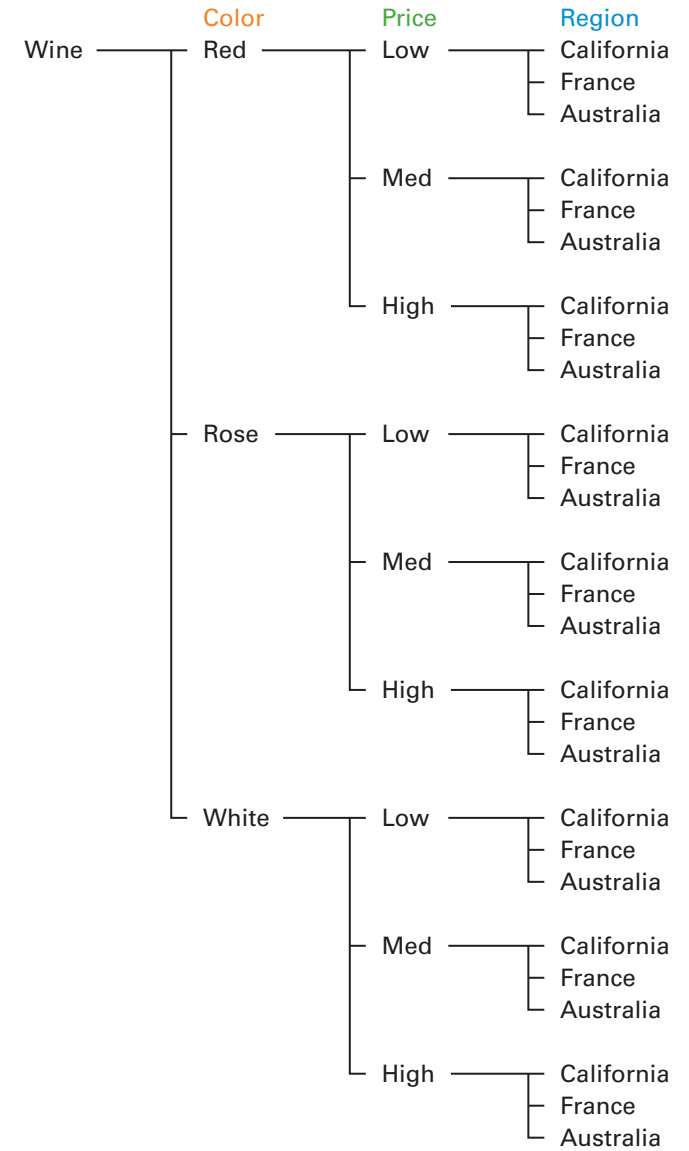


# Wine Tree Combinations

5. Color, Region, Price



6. Color, Price, Region



## Cube Structures

Any one of the 6 trees is a valid representation of the data—and any one might be useful. How should we think about the data? Is there a more “natural” form?

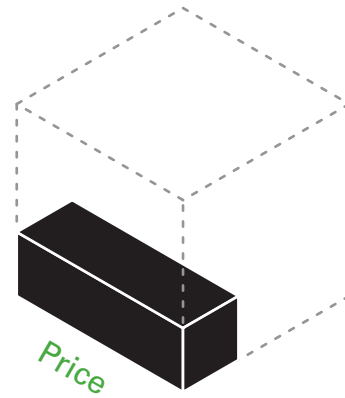
In this case, the data has three dimensions. The data suggests a cube. We might say that its natural shape is a cube. Of course, a real database might have many more dimensions. While 4 or 5 or 6 or more dimensional spaces are difficult to represent, we can describe data spaces as N-dimensional—with the ability to be sliced or filtered along each dimension.

The next section shows how that might work.

# Wine Cube

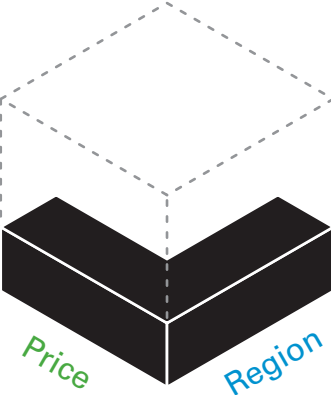
Using the same set of information as in our tree structure, we create the dimensions of the cube:

Price is the first dimension.



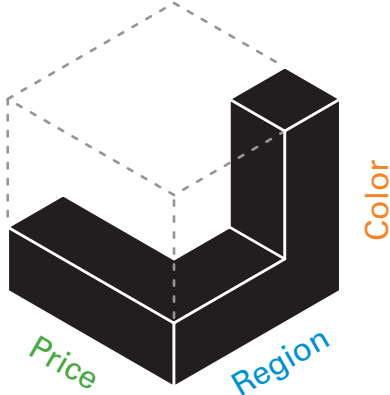
# Wine Cube

Region is the second dimension.



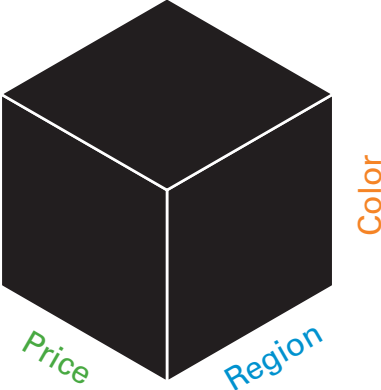
# Wine Cube

Color is the third, and final dimension.



# Wine Cube

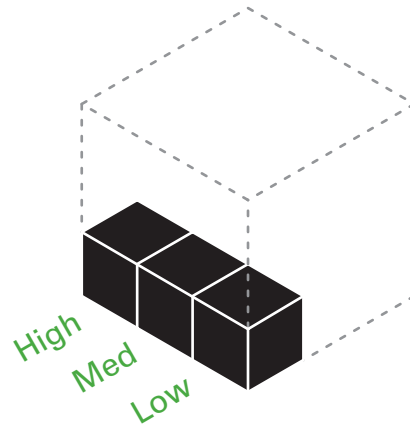
This completes our wine collection.



# Wine Cube

We also know that each of our three dimensions has its own sub-categories:

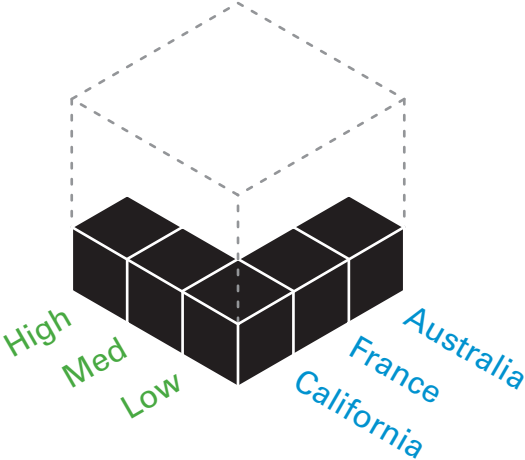
Price has High, Medium, and Low.





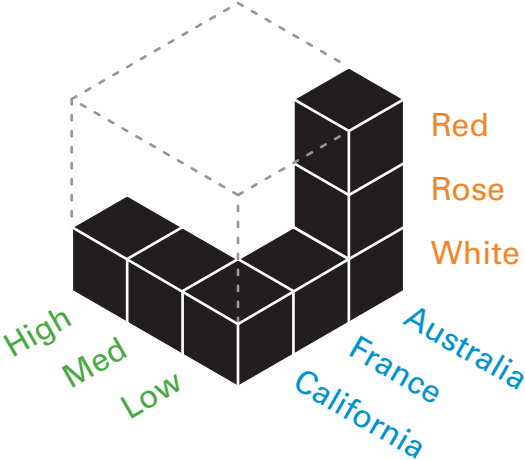
# Wine Cube

Region has California, France, and Australia.



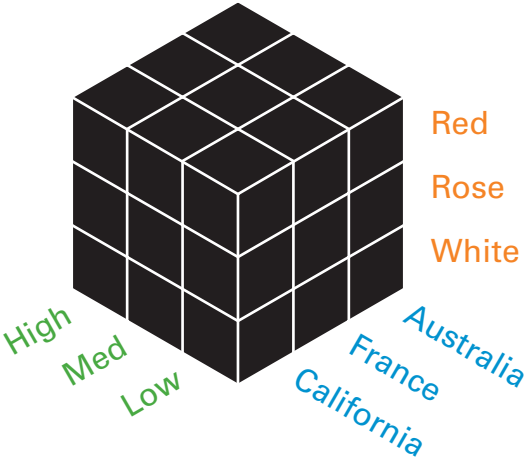
# Wine Cube

Color has Red, Rose, and White.



# Wine Cube

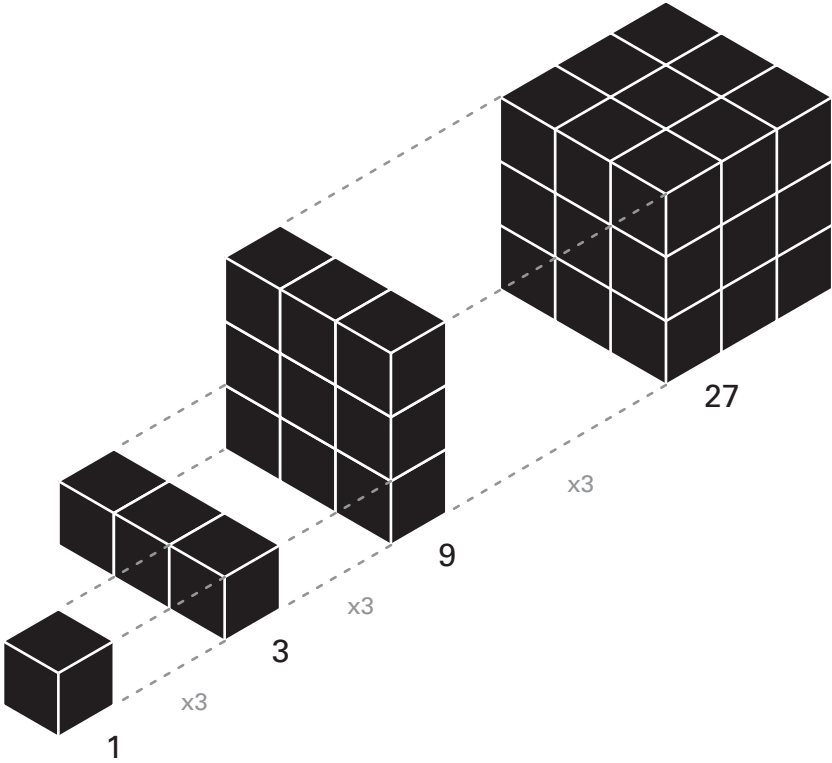
Adding these sub-categories divides our finished wine cube into 27 cells.



# Wine Cube

Three cells make a row.  
Three rows make a block.  
Three blocks make up the cube.

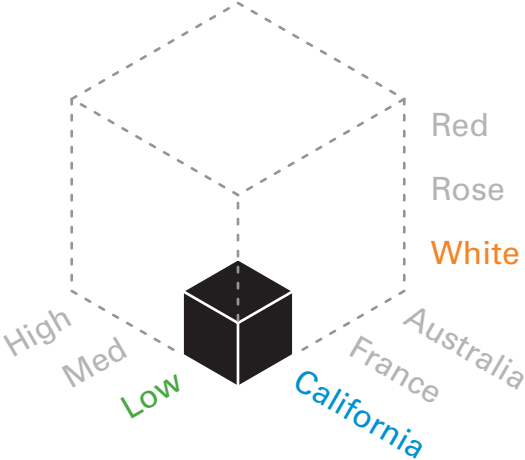
Below is a tally of single cells.



# Wine Cube

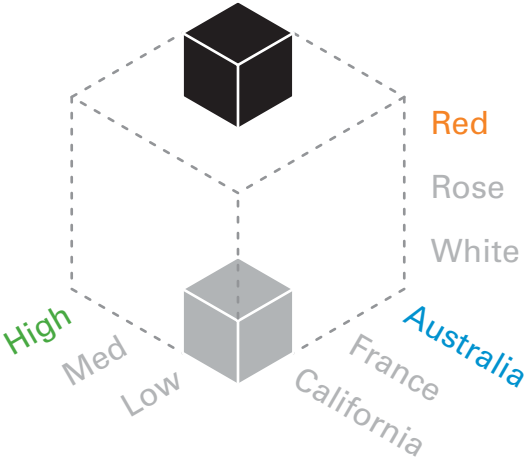
Each leaf in the tree corresponds to a cell in the cube. Each cell has coordinates: x, y, z.

1,1,1 = Low, California, White.



# Wine Cube

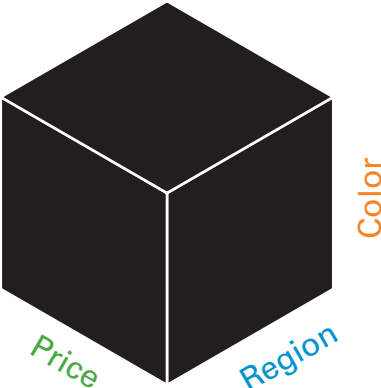
3,3,3 = High, Australia, Red.



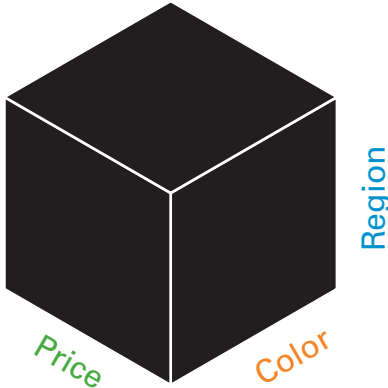
# Wine Cube Combinations

Re-ordering the dimensions provides the same six combinations as the tree structure.

1. Price, Region, Color

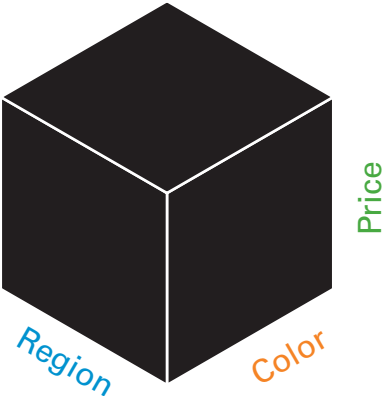


2. Price, Color, Region

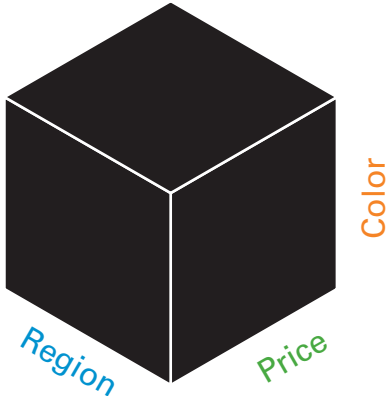


# Wine Cube Combinations

3. Region, Color, Price



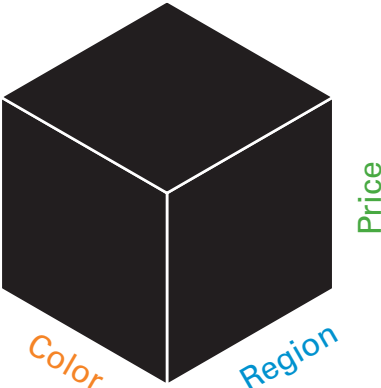
4. Region, Price, Color



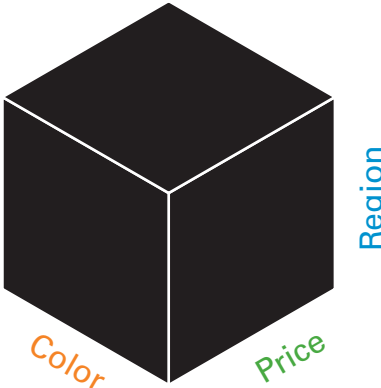


# Wine Cube Combinations

5. Color, Region, Price



6. Color, Price, Region



## Possible Interfaces

Now how would a user interact and navigate within this set of information? One could imagine a variety of interfaces to narrow down choices:

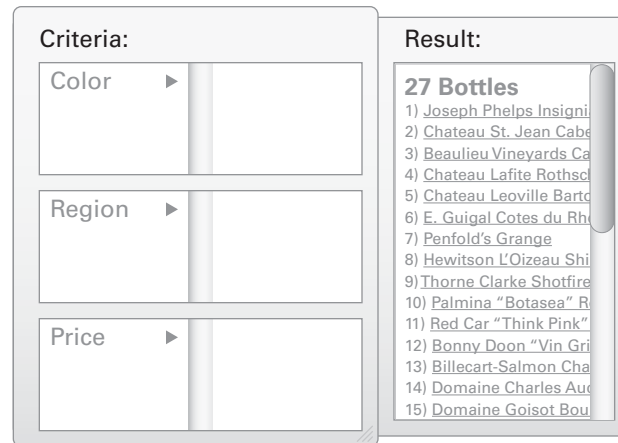
- Column List
- Pull-down Menus
- Sliders
- Checkboxes

The following pages show some examples of possible interfaces.

# Column List

This interface is divided into our three categories but one could imagine it being very flexible to accommodate any number of categories and sub-categories.

Notice that nothing is selected and the user receives the maximum amount of 27 results (real cases would have many more).



# Column List

The user selects the first category of Color, then selects its sub-category of White.

The results returned are narrowed to 9.

**Criteria:**

Color ▶	Red Rose <b>White</b>
Region ▶	California France Australia
Price ▶	Low Med High

**Result:**

**9 Bottles**

- 1) [KongsgaardThe Judge C](#)
- 2) [Brewer-Clifton Chardonn](#)
- 3) [La Crema Chardonnay](#)
- 4) [Domaine Leflaive Le Mon](#)
- 5) [Domaine Leflaive Bourgo](#)
- 6) [Domaine de la Pepiere M](#)
- 7) [Penfold's Yattarna Chardo](#)
- 8) [Mesh Riesling Eden Valle](#)
- 9) [Marquis Phillips Holly's B](#)

# Column List

The user selects the second category of Region, then selects its sub-category of California.

The results returned are now narrowed to 3.

The image shows a user interface for filtering wine bottles. It consists of two main panels: 'Criteria' and 'Result'.

**Criteria:**

- Color:** A dropdown menu with three options: Red, Rose, and White. 'White' is currently selected.
- Region:** A dropdown menu with three options: California, France, and Australia. 'California' is currently selected.
- Price:** A dropdown menu with three options: Low, Med, and High. No option is currently selected.

**Result:**

**3 Bottles**

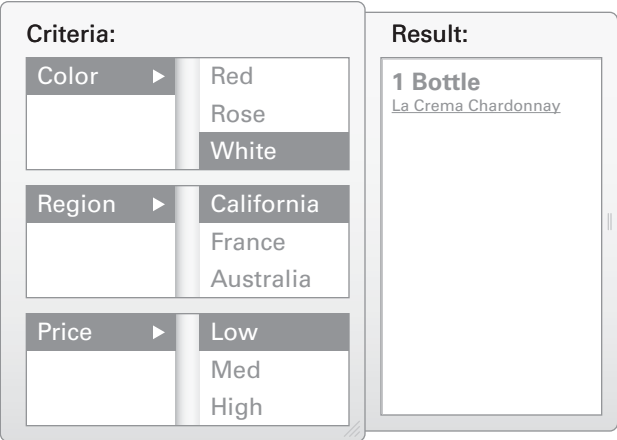
- 1) [Kongsgaard The Judge C](#)
- 2) [Brewer-Clifton Chardonn](#)
- 3) [La Crema Chardonnay](#)

# Column List

The user selects the third category of Price, then selects its sub-category of Low.

The results returned are now narrowed to a single bottle.

Of course, users could begin with Region or Price.



# Pull-down Menus

This interface utilizes pull-down menus to organize our three categories. The user could begin with any pull-down menu.

Again, nothing is selected, and the maximum result of 27 bottles is returned.

**Input:**

Color:

Region:

Price:

**Output:**

**27 Bottles**

- 1) [Joseph Phelps Insignia](#)
- 2) [Chateau St. Jean Cabernet Sa](#)
- 3) [Beaulieu Vineyards Cabernet S](#)
- 4) [Chateau Lafite Rothschild](#)
- 5) [Chateau Leoville Barton](#)
- 6) [E. Guigal Cotes du Rhone](#)
- 7) [Penfold's Grange](#)
- 8) [Hewitson L'Oizeau Shiraz](#)
- 9) [Thorne Clarke Shotfire Ridge S](#)
- 10) [Palmina "Botasea" Rosato](#)
- 11) [Red Car "Think Pink" Rose](#)
- 12) [Bonny Doon "Vin Gris de Cig](#)
- 13) [Billecart-Salmon Champagne](#)
- 14) [Domaine Charles Audoin Ma](#)
- 15) [Domaine Gaisot Bourgogne](#)
- 16) [Chambers Rosewood Rare M](#)

# Pull-down Menus

The user selects the first category of Color, then selects its sub-category of White.

The results returned are narrowed to 9.

**Input:**

Color:

Region:

Price:

**Output:**

**9 Bottles**

- 1) [Kongsgaard The Judge Chardon](#)
- 2) [Brewer-Clifton Chardonnay Swe](#)
- 3) [La Crema Chardonnay](#)
- 4) [Domaine Leflaive Le Montrache](#)
- 5) [Domaine Leflaive Bourgogne Bl](#)
- 6) [Domaine de la Pepiere Muscade](#)
- 7) [Penfold's Yattarna Chardonnay](#)
- 8) [Mesh Riesling Eden Valley](#)
- 9) [Marquis Phillips Holly's Blend](#)

Color options: All, Red, Rose, White



# Pull-down Menus

The user selects the second category of Region, then selects its sub-category of California.

The results returned are now narrowed to 3.

**Input:**

Color:

Region:

Price:

**Output:**

**3 Bottles**

- 1) [Kongsgaard The Judge Chardon](#)
- 2) [Brewer-Clifton Chardonnay Swe](#)
- 3) [La Crema Chardonnay](#)

All  
California  
France  
Australia

# Pull-down Menus

The user selects the third category of Price, then selects its sub-category of Low.

The results returned are now narrowed to a single bottle.

The image shows a user interface for a search filter. It is divided into two main sections: 'Input' and 'Output'.  
**Input:** This section contains three dropdown menus. The first is labeled 'Color' and has 'White' selected. The second is labeled 'Region' and has 'California' selected. The third is labeled 'Price' and has 'Low' selected. A blue line connects the 'Price' dropdown to a separate menu on the right.  
**Output:** This section shows the results of the search. It displays '1 Bottle' and a link to 'La Crema Chardonnay'.  
**Price Menu:** A separate menu is shown to the right of the 'Price' dropdown, containing four options: 'All', 'High', 'Medium', and 'Low'. The 'Low' option is highlighted with a dark background.

# Sliders

This interface utilizes sliders to narrow down the choices of each category. Sliders are important when dealing with a large amount of data because they allow for continuous or nearly continuous ranges, i.e., 0 – 255.

The sliders specify that all sub-categories are being viewed, the maximum result of 27 bottles is returned.

**Input:**

Color	Region	Price
▼	▼	▼
Red	California	High
—	—	—
Rose	France	Medium
—	—	—
White	Australia	Low
▲	▲	▲

**Output:**

**27 Bottles**

- 1) [Joseph Phelps Insignia](#)
- 2) [Chateau St. Jean Cabernet Sa](#)
- 3) [Beaulieu Vineyards Cabernet S](#)
- 4) [Chateau Lafite Rothschild](#)
- 5) [Chateau Leoville Barton](#)
- 6) [E. Guigal Cotes du Rhone](#)
- 7) [Penfold's Grange](#)
- 8) [Hewitson L'Oizeau Shiraz](#)
- 9) [Thorne Clarke Shotfire Ridge S](#)
- 10) [Palmina "Botasea" Rosato](#)
- 11) [Red Car "Think Pink" Rose](#)
- 12) [Bonny Doon "Vin Gris de Cig](#)
- 13) [Billecart-Salmon Champagne](#)
- 14) [Domaine Charles Audoin Ma](#)
- 15) [Domaine Gaisot Bourgogne](#)
- 16) [Chambers Rosewood Rare M](#)

# Sliders

The user selects the first category of Color, then moves the slider up to the single sub-category of White.

The results returned are narrowed to 9.

**Input:**

Color	Region	Price
—	▼	▼
Red	California	High
—	—	—
Rose	France	Medium
▼	—	—
White	Australia	Low
▲	▲	▲

**Output:**

**9 Bottles**

- 1) [Kongsgaard The Judge Chardon](#)
- 2) [Brewer-Clifton Chardonnay Swe](#)
- 3) [La Crema Chardonnay](#)
- 4) [Domaine Leflaive Le Montrache](#)
- 5) [Domaine Leflaive Bourgogne Bl](#)
- 6) [Domaine de la Pepiere Muscade](#)
- 7) [Penfold's Yattarna Chardonnay](#)
- 8) [Mesh Riesling Eden Valley](#)
- 9) [Marquis Phillips Holly's Blend](#)

# Sliders

The user selects the second category of Region, then moves the slider up to the single sub-category of California.

The results returned are now narrowed to 3.

**Input:**

Color	Region	Price
—	▼	▼
Red	California	High
—	▲	—
Rose	France	Medium
▼	—	—
White	Australia	Low
▲	—	▲

**Output:**

**3 Bottles**

- 1) [Kongsgaard The Judge Chardon](#)
- 2) [Brewer-Clifton Chardonnay Swe](#)
- 3) [La Crema Chardonnay](#)

# Sliders

The user selects the final category of Price, then moves the slider down to the single sub-category of Low.

The results returned are now narrowed to a single bottle.

One advantage of sliders is that they enable users to quickly expand a category that is already been narrowed.

**Input:**

Color	Region	Price
—	▼	—
Red	California	High
—	▲	—
Rose	France	Medium
▼	—	▼
White	Australia	Low
▲	—	▲

**Output:**

**1 Bottle**

[La Crema Chardonnay](#)

# Checkboxes

This interface reveals the sub-categories of our three categories at first look. Another strength of the checkboxes is that the user is able to choose whichever box they want, in any order they want to. This can also be done in the column list and pull-down menus, but is less intuitive as they are placed on top of one another, whereas here, the checkboxes are not as hierarchical.

We will utilize this checkbox interface in the following flow example.

**Criteria:**

<input checked="" type="checkbox"/> Red	<input checked="" type="checkbox"/> California	<input checked="" type="checkbox"/> High
<input checked="" type="checkbox"/> Rose	<input checked="" type="checkbox"/> France	<input checked="" type="checkbox"/> Med
<input checked="" type="checkbox"/> White	<input checked="" type="checkbox"/> Australia	<input checked="" type="checkbox"/> Low

**Result:**

**27 Bottles**

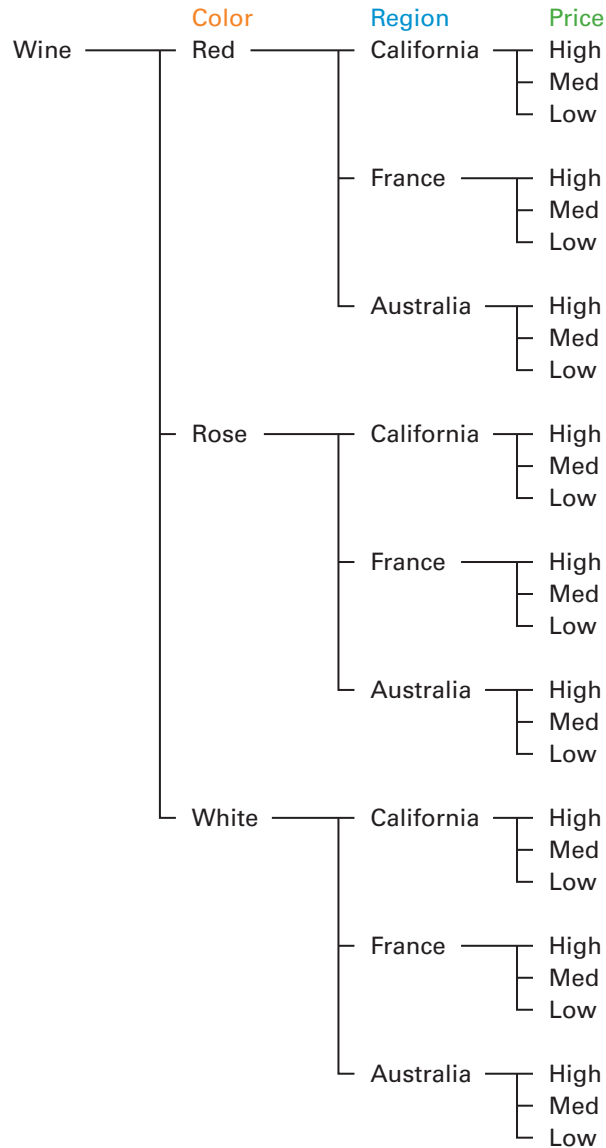
- 1) [Joseph Phelps Insignia](#)
- 2) [Chateau St. Jean Cabernet Sauvignon Sonoma](#)
- 3) [Beaulieu Vineyards Cabernet Sauvignon](#)
- 4) [Chateau Lafite Rothschild](#)
- 5) [Chateau Leoville Barton](#)
- 6) [E. Guigal Cotes du Rhone](#)
- 7) [Penfold's Grange](#)
- 8) [Hewitson L'Oizeau Shiraz](#)
- 9) [Thorne Clarke Shotfire Ridge Shiraz](#)
- 10) [Palmina "Botasea" Rosato](#)

## Flow Example

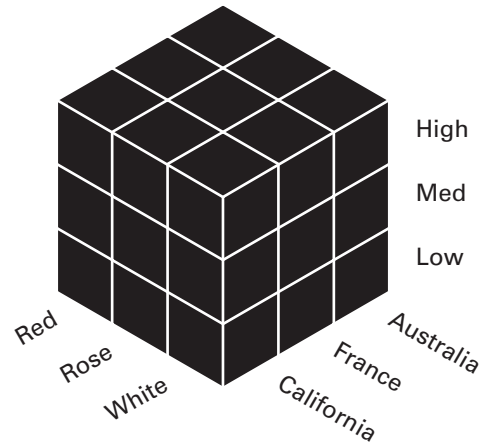


# All Wine

## Tree



## Cube



## Interface

**Criteria:**

<input checked="" type="checkbox"/> Red	<input checked="" type="checkbox"/> California	<input checked="" type="checkbox"/> High
<input checked="" type="checkbox"/> Rose	<input checked="" type="checkbox"/> France	<input checked="" type="checkbox"/> Med
<input checked="" type="checkbox"/> White	<input checked="" type="checkbox"/> Australia	<input checked="" type="checkbox"/> Low

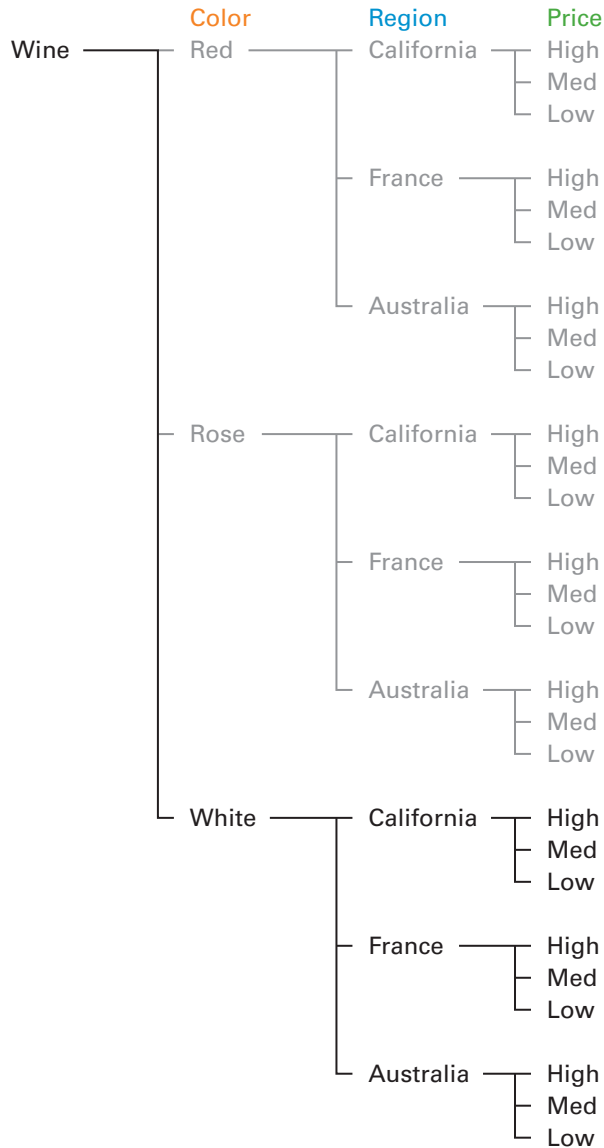
**Result:**

**27 Bottles**

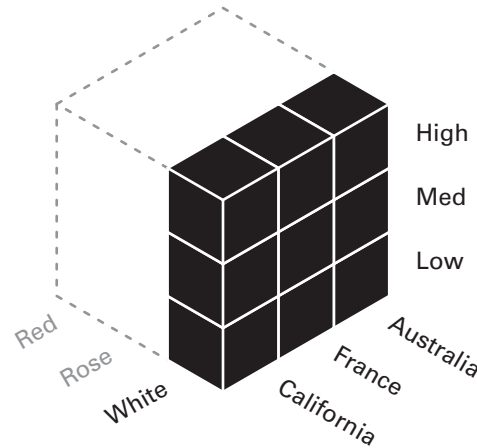
- 1) [Joseph Phelps Insignia](#)
- 2) [Chateau St. Jean Cabernet Sauvignon Sonoma](#)
- 3) [Beaulieu Vineyards Cabernet Sauvignon](#)
- 4) [Chateau Lafite Rothschild](#)
- 5) [Chateau Leoville Barton](#)
- 6) [E. Guigal Cotes du Rhone](#)
- 7) [Penfold's Grange](#)
- 8) [Hewitson L'Oizeau Shiraz](#)
- 9) [Thorne Clarke Shotfire Ridge Shiraz](#)
- 10) [Palmina "Botasea" Rosato](#)

# Color

## Tree



## Cube



## Interface

**Criteria:**

<input type="checkbox"/> Red	<input checked="" type="checkbox"/> California	<input checked="" type="checkbox"/> High
<input type="checkbox"/> Rose	<input checked="" type="checkbox"/> France	<input checked="" type="checkbox"/> Med
<input checked="" type="checkbox"/> White	<input checked="" type="checkbox"/> Australia	<input checked="" type="checkbox"/> Low

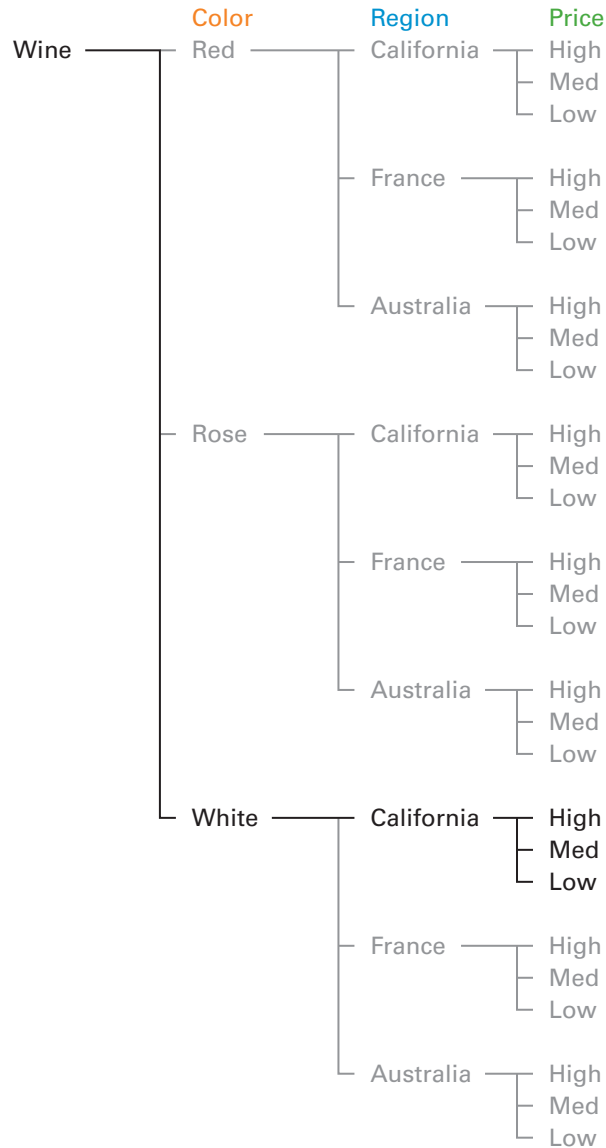
**Result:**

**9 Bottles**

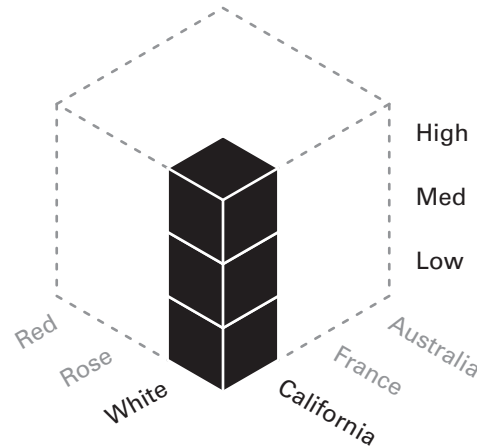
- 1) [Kongsgaard The Judge Chardonnay](#)
- 2) [Brewer-Clifton Chardonnay Sweeney Canyon](#)
- 3) [La Crema Chardonnay](#)
- 4) [Domaine Leflaive Le Montrachet](#)
- 5) [Domaine Leflaive Bourgogne Blanc](#)
- 6) [Domaine de la Pepiere Muscadet Sevre et Maine](#)
- 7) [Penfold's Yattarna Chardonnay](#)
- 8) [Mesh Riesling Eden Valley](#)
- 9) [Marquis Phillips Holly's Blend](#)

# Color/Region

## Tree



## Cube



## Interface

**Criteria:**

<input type="checkbox"/> Red	<input checked="" type="checkbox"/> California	<input checked="" type="checkbox"/> High
<input type="checkbox"/> Rose	<input type="checkbox"/> France	<input checked="" type="checkbox"/> Med
<input checked="" type="checkbox"/> White	<input type="checkbox"/> Australia	<input checked="" type="checkbox"/> Low

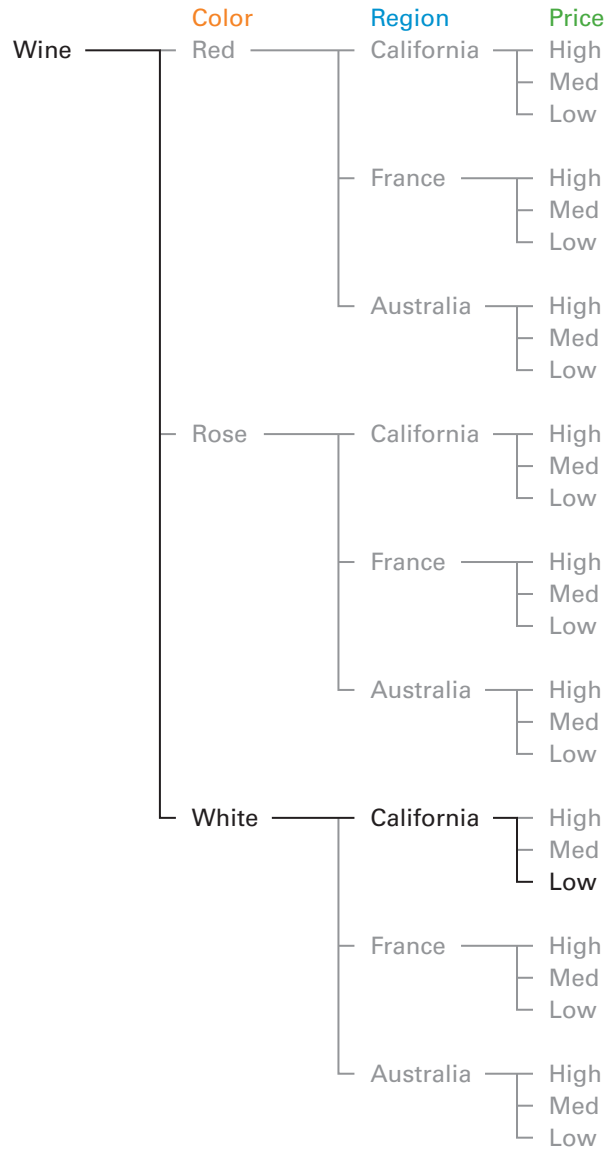
**Result:**

**3 Bottles**

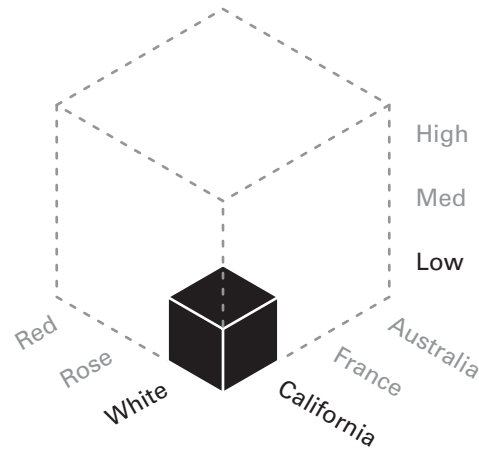
- 1) [Kongsgaard The Judge Chardonnay](#)
- 2) [Brewer-Clifton Chardonnay Sweeney Canyon](#)
- 3) [La Crema Chardonnay](#)

# Color/Region/Price

## Tree



## Cube



## Interface

**Criteria:**

<input type="checkbox"/> Red	<input checked="" type="checkbox"/> California	<input type="checkbox"/> High
<input type="checkbox"/> Rose	<input type="checkbox"/> France	<input type="checkbox"/> Med
<input checked="" type="checkbox"/> White	<input type="checkbox"/> Australia	<input checked="" type="checkbox"/> Low

**Result:**

**1 Bottle**  
[La Crema Chardonnay](#)

# Pivoting

Here's where things get really interesting.

The user has narrowed down to White, California, Low. But suppose she doesn't like the results or she wants to explore other options. In a tree structure she would have to back out to the root and then travel back down the tree. Finding all the options for low cost would require an awful lot of climbing up and down the tree.

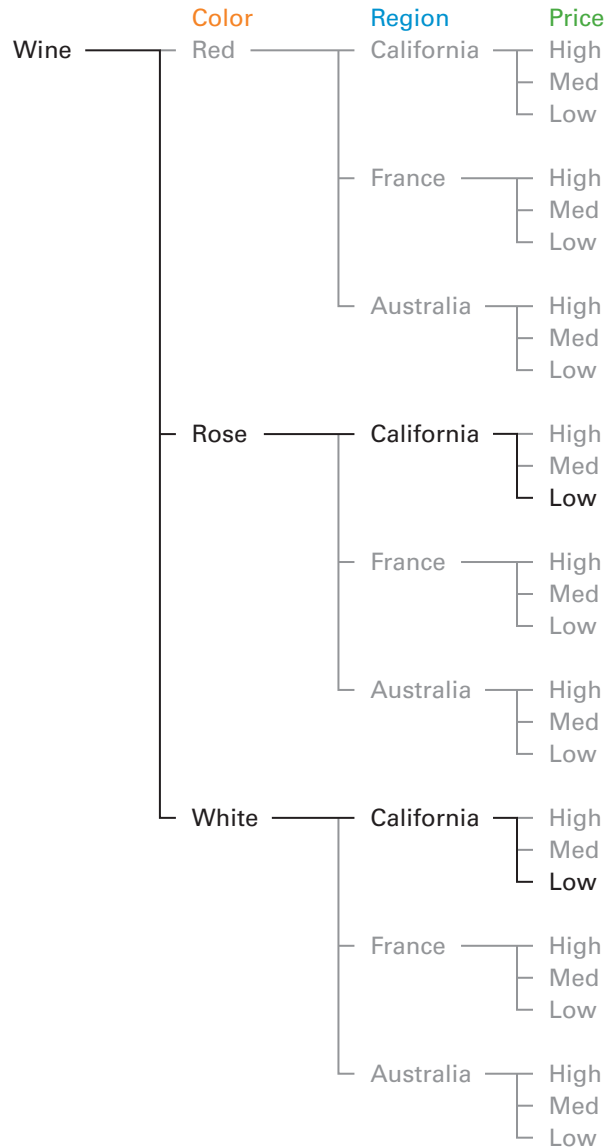
The result would be a frustrated user.

The navigation solution involves two things.

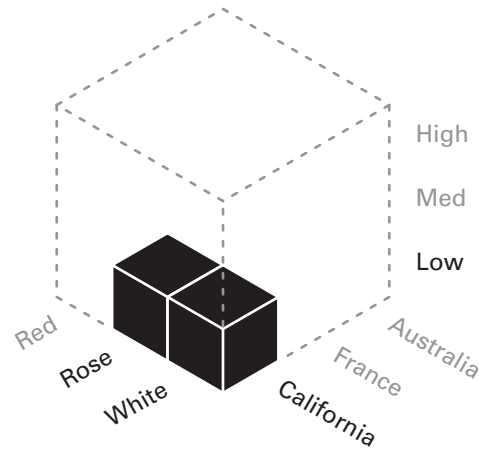
First, conceiving the data as an N-dimensional matrix and second recognizing that users may narrow along one path and then turn and "pivot" to expand back up another path—before narrowing again.

# California/Low/More Colors

Tree



Cube



Interface

**Criteria:**

<input type="checkbox"/> Red	<input checked="" type="checkbox"/> California	<input type="checkbox"/> High
<input checked="" type="checkbox"/> Rose	<input type="checkbox"/> France	<input type="checkbox"/> Med
<input checked="" type="checkbox"/> White	<input type="checkbox"/> Australia	<input checked="" type="checkbox"/> Low

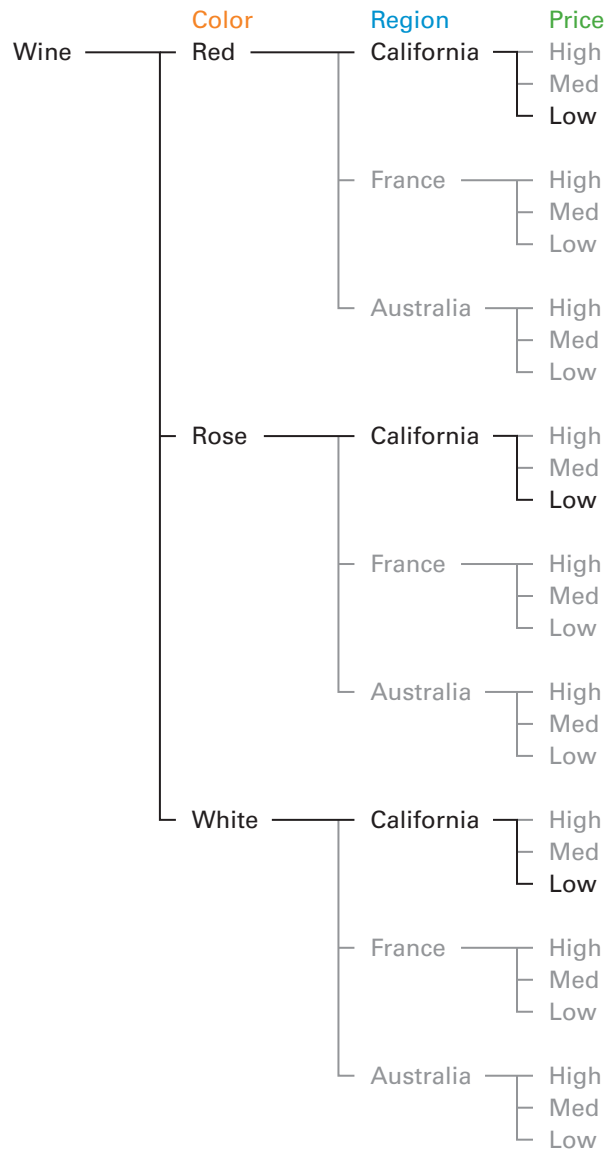
**Result:**

**2 Bottles**

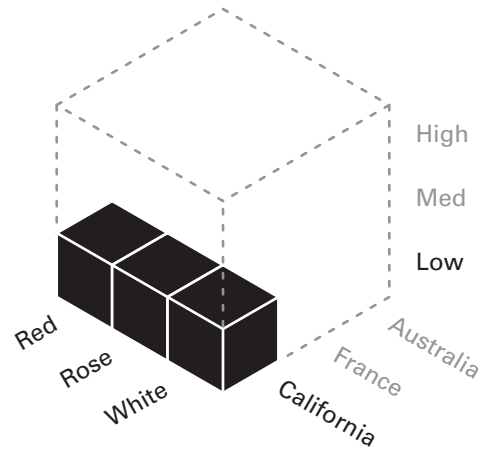
- 1) [La Crema Chardonnay](#)
- 2) [Bonny Doon "Vin Gris de Cigare"](#)

# California/Low/All Colors

Tree



Cube



Interface

**Criteria:**

<input checked="" type="checkbox"/> Red	<input checked="" type="checkbox"/> California	<input type="checkbox"/> High
<input checked="" type="checkbox"/> Rose	<input type="checkbox"/> France	<input type="checkbox"/> Med
<input checked="" type="checkbox"/> White	<input type="checkbox"/> Australia	<input checked="" type="checkbox"/> Low

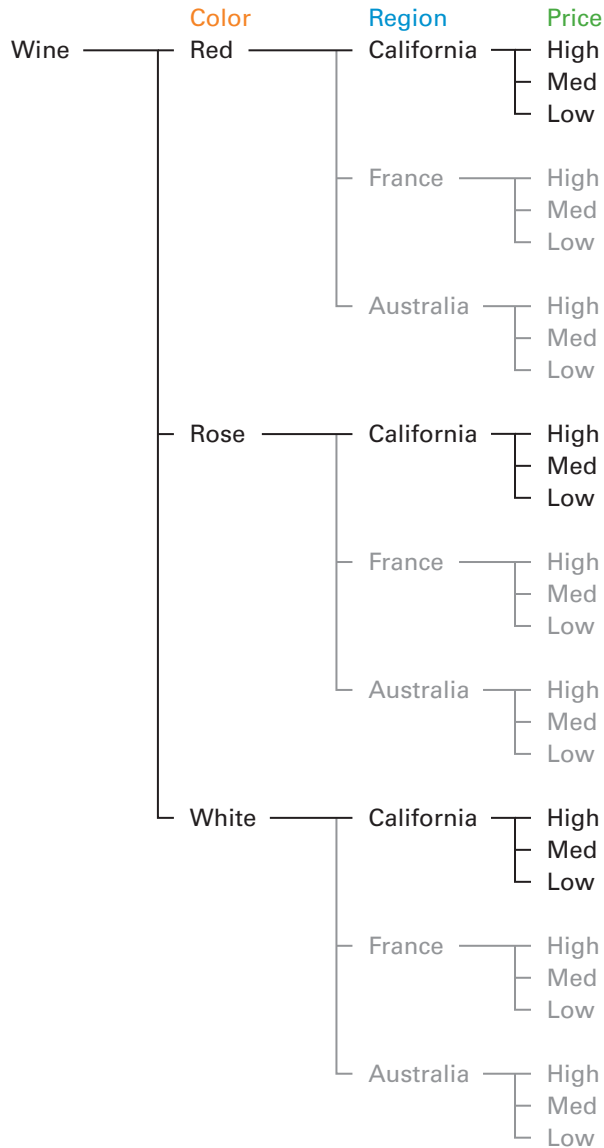
**Result:**

**3 Bottles**

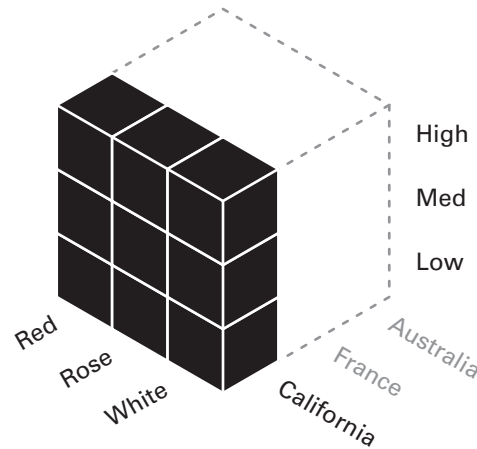
- 1) [La Crema Chardonnay](#)
- 2) [Bonny Doon "Vin Gris de Cigare"](#)
- 3) [Beaulieu Vineyards Cabernet Sauvignon](#)

# California/All Colors/All Prices

Tree



Cube



Interface

**Criteria:**

<input checked="" type="checkbox"/> Red	<input checked="" type="checkbox"/> California	<input checked="" type="checkbox"/> High
<input checked="" type="checkbox"/> Rose	<input type="checkbox"/> France	<input checked="" type="checkbox"/> Med
<input checked="" type="checkbox"/> White	<input type="checkbox"/> Australia	<input checked="" type="checkbox"/> Low

**Result:**

**9 Bottles**

- 1) [La Crema Chardonnay](#)
- 2) [Bonny Doon "Vin Gris de Cigare"](#)
- 3) [Beaulieu Vineyards Cabernet Sauvignon](#)
- 4) [Brewer-Clifton Chardonnay Sweeney Canyon](#)
- 5) [Red Car "Think Pink" Rose](#)
- 6) [Chateau St. Jean Cabernet Sauvignon Sonoma](#)
- 7) [Kongsgaard The Judge Chardonnay](#)
- 8) [Palmina "Botasea" Rosato](#)
- 9) [Joseph Phelps Insignia](#)

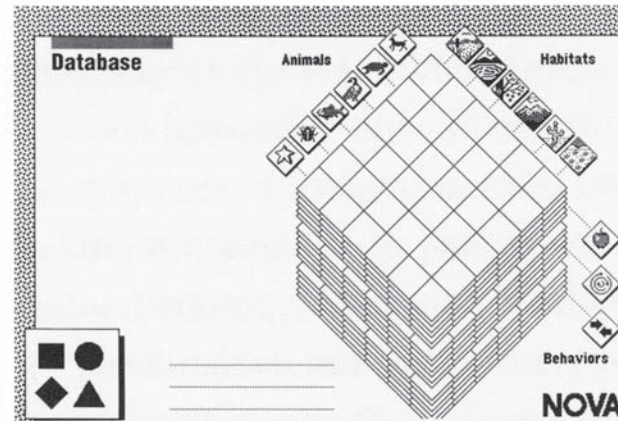


## **Practical Applications**

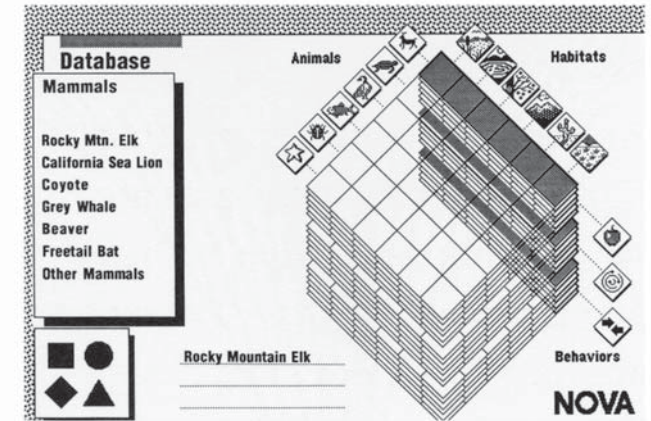
# Interactive Nova

In 1988, Paul Souza designed this interface to a database of animal information, their habitats, and behavior. Clicking the icon for mammals displays a list of sub-categories. Clicking on the icon for mountains displays a list of sub-categories. Clicking on the icon for sensing narrows the options further. After all the parameters have been set, clicking the 'Go To' diamond takes the user to the desired screen.

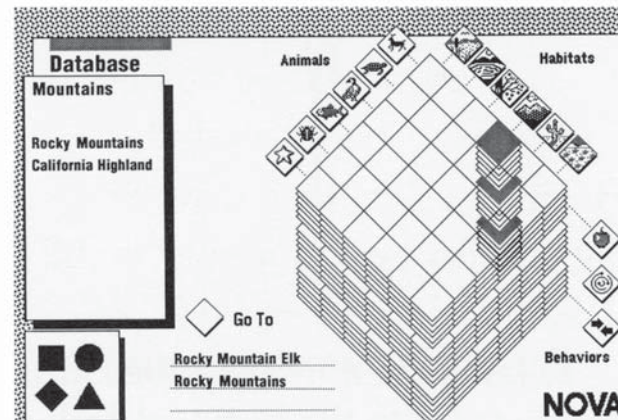
1. All Dimensions



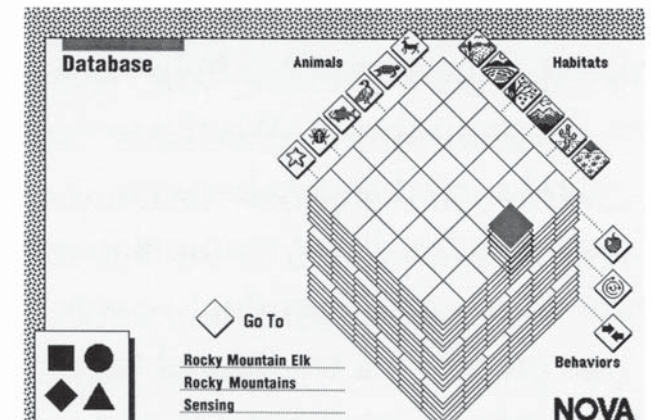
2. Animal



3. Animal/Habitat



4. Animal/Habitat/Behavior



# Sun Microsystems

In 2003, Greg Baker designed a search interface for Sun Microsystems. It is organized by three main tabs: Find a Partner, Find a Product, and Find a Solution. Each tab contains a different set of information, what is unique is that the interface provides three ways to browse the same set of information. The following pages show an example of performing a search and filtering the results with different filters.


The screenshot shows the Sun Microsystems iForce Partner Directory search interface. At the top, there is a navigation bar with links for "How to Buy", "My Sun", and "Worldwide Sites", along with a search box. Below this is a header with the Sun Microsystems logo and three main navigation tabs: "Products & Services" and "Support & Training". The main content area is titled "Find a Partner" and includes a search form with a text input field, a dropdown menu for "Entire Directory" (with options for "Within Partners", "Within Solutions", and "Within Products"), and an "Advanced Search" link. Below the search form is a section titled "Pick a Way to Browse Partners" with three main categories: "Industry" (Aerospace, Automotive, Banking/Insurance), "Application Area" (Application Hosting, Business Intelligence/Data Warehousing, CRM/PRM), and "Location" (Located In, Sold In). To the right of these categories is a "Featured Partners" section with three partner cards, each featuring a small image and a "Partner Name" followed by a placeholder text and a "More" link. At the bottom of the featured partners section is a list of partner names: Accenture, Aceso Commerce Inc., ADM Premier Limited, Air2Web, Inc., American Management Systems, and Blue Loaic. On the right side of the page, there is a "Global Partner Directory" section with a language picker and a "Contact Sun" link. Below that is a "Welcome, (User Name)" section with links for "Edit Account" and "Log Out". Further down is a "Regional Directories" section with links for Argentina, France, Greece, and Spain. At the bottom right, there is a "Headline" section with a subhead and a "More" link.

# Sun Microsystems

The user switches from the Find a Partner tab to the Find a Product tab. Notice the addition of the three browse filters mentioned on the previous page: Filter results by: Application Area, Sun Technologies, or Location.

The user chooses to filter their results by Application Area, and then selects Healthcare.

sun.com      How to Buy | My Sun | Worldwide Sites      Search  >>

 [→ Products & Services](#)      [→ Support & Training](#)

Home > iForce > Partner Directory > Products > Product Type > Hardware > Peripherals >

## Input Devices

[Find a Partner](#)   [Find a Product](#)   [Find a Solution](#)

Filter results by: **Application Area** | Sun Technologies | Location      [Hide Browse Filters](#)

- » Aerospace (45)
- » Automotive (3)
- » Banking/Insurance (1)
- » Biotechnology (13)
- » Chemical (5)
- » Digital Media (5)
- » Education (99)
- » Engery (68)
- » Engineering (15)
- » Finance (2)
- » Government (12)
- » Healthcare (100)
- » Legal (48)
- » Life Sciences (31)
- » Manufacturing (77)
- » Retail Distribution (3)
- » Sales/Marketing (1)
- » Service Provider (8)

Search:       Entire Directory - Within Products      ----- Within Input Devices >>

[» Advanced Search](#)

**Global Partner Directory**

[» Contact Sun](#)

**Welcome, (User Name)**

[» Edit Account](#)

[» Log Out](#)


---

[» Edit Partner Directory Information](#)


---

[» How to Use this Directory](#)

### Featured Products



**Product Name**  
Body coy lorem Ipsem dolor sit amet, consectetur.  
[» More](#)




**Product Name**  
Body coy lorem Ipsem dolor sit amet, consectetur.  
[» More](#)

Page 1 (1-50 of 325)      Pages: 1 - 50 - 100 - 150 - 200 - 250 - 300 | [» Next](#)

**Browse Input Devices**      Sort by: **Relevance** >>

Product Name	Partner Name	Description
<a href="#">→ Intuos2 Graphics Tablet</a> (Hardware)	Wacom Technology Corp.	The Intuos2 series tablets, with their transparent overlay and adjustable menu strip, provide the right balance of professional features, functionality and size to meet the needs of creative.  <b>Certification: Solaris Ready</b>
<a href="#">→ Product Name</a>	Partner Name	The Intuos2 series tablets, with their



**Headline**

**Subhead**

Body copy lorem Ipsem dolor sit ament, consectetur  
[» More](#)

# Sun Microsystems

After the user selects Healthcare, the browse filters change out depending on the current choice and provide a new set of options.

The user now decides to “pivot” and filter their results by Location instead of Application Area.

The screenshot shows the Sun Microsystems website interface. At the top, there are navigation links for 'How to Buy', 'My Sun', and 'Worldwide Sites', along with a search bar. Below this is a header with 'Sun microsystems' logo and buttons for 'Products & Services' and 'Support & Training'. A breadcrumb trail reads: Home > iForce > Partner Directory > Products > Product Type > Hardware > Peripherals > Input Devices.

The main content area is titled 'Input Devices' and includes a filter section for 'Only In: Healthcare'. It has three tabs: 'Find a Partner', 'Find a Product', and 'Find a Solution'. The 'Find a Product' tab is active, showing filter results by 'Application Area', 'Sun Technologies', and 'Location'. A search box is present with a dropdown menu showing options like 'Entire Directory', 'Within Products', 'Within Input Devices (All)', and 'Within Input Devices (Filtered)'. A 'Hide Browse Filters' button is also visible.

Below the filters, there is a table of results. The table has columns for 'Product Name', 'Partner Name', and 'Description'. The first row is for 'Intuos2 Graphics Tablet (Hardware)' by 'Wacom Technology Corp.'. The second and third rows are for 'Product Name (Hardware)' by 'Partner Name'. Each row includes a 'Certification: Solaris Ready' badge.

On the right side of the page, there is a 'Global Partner Directory' section with a 'Contact Sun' button. Below that is a 'Welcome, (User Name)' section with links for 'Edit Account' and 'Log Out'. Further down is a 'How to Use this Directory' link. At the bottom right, there is a 'Headline' section with a subhead and body copy.

Product Name	Partner Name	Description
→ Intuos2 Graphics Tablet (Hardware)	Wacom Technology Corp.	The Intuos2 series tablets, with their transparent overlay and programmable menu strip, provide the right balance of professional features, functionality and size to meet the needs of creative. <b>Certification: Solaris Ready</b>
→ Product Name (Hardware)	Partner Name	The Intuos2 series tablets, with their transparent overlay and programmable menu strip, provide the right balance of. <b>Certification: Solaris Ready</b>
→ Product Name (Hardware)	Partner Name	The Intuos2 series tablets, with their transparent overlay and programmable menu strip, provide the right balance of. <b>Certification: Solaris Ready</b>

# Sun Microsystems

Now that the user has switched to filter by Location, the browse filters change out again and provide a new set of options. The user selects Sold In.

Notice that the breadcrumb has not changed, effectively providing a point of reference for the user.

The screenshot shows the Sun Microsystems website interface. At the top, there is a navigation bar with 'sun.com', 'How to Buy', 'My Sun', and 'Worldwide Sites'. A search box is on the right. Below the navigation bar are three main sections: 'Products & Services' (yellow), 'Support & Training' (red), and a breadcrumb trail: 'Home > iForce > Partner Directory > Products > Product Type > Hardware > Peripherals >'. The main heading is 'Input Devices'. Below this, there are tabs for 'Find a Partner', 'Find a Product', and 'Find a Solution'. A filter bar shows 'Filter results by: Application Area | Sun Technologies | Location' with a 'Hide Browse Filters' button. Below the filter bar, there are links for 'Located In (45)' and 'Sold In (50)'. A search box is present with a dropdown menu open, showing options: 'Entire Directory', '- Within Products', '---- Within Input Devices (All)', and '---- Within Input Devices (Filtered)'. A search button is to the right of the dropdown. Below the search box is a link for 'Advanced Search'. On the right side of the page, there is a 'Global Partner Directory' section with a 'Contact Sun' link, a 'Welcome, (User Name)' section with 'Edit Account' and 'Log Out' links, and a link for 'Edit Partner Directory Information'. At the bottom right, there is a 'How to Use this Directory' link. The main content area shows a table of 'Browse Input Devices' with columns for 'Product Name', 'Partner Name', and 'Description'. The table is sorted by 'Relevance'. The first row is for 'Intuos2 Graphics Tablet (Hardware)' by 'Wacom Technology Corp.'. The second and third rows are for 'Product Name (Hardware)' by 'Partner Name'. Each row includes a 'Certification: Solaris Ready' badge. The table is on 'Page 1 (1-50 of 100)' and has 'Pages: 1 - 50 - 100 | Next' navigation. On the far right, there is a 'Headline' section with an image of a person using a tablet and a 'Subhead' section with placeholder text.

sun.com      How to Buy | My Sun | Worldwide Sites      Search

→ Products & Services      → Support & Training

Home > iForce > Partner Directory > Products > Product Type > Hardware > Peripherals >

## Input Devices

Only In: Healthcare

Find a Partner    Find a Product    Find a Solution

Filter results by: Application Area | Sun Technologies | Location      Hide Browse Filters

» Located In (45)      » Sold In (50)

Search:    
 ----- Within Input Devices (All)   
 ----- Within Input Devices (Filtered)      >>

» Advanced Search

Global Partner Directory

» Contact Sun

Welcome, (User Name)

» Edit Account   
 » Log Out

» Edit Partner Directory Information

» How to Use this Directory

Page 1 (1-50 of 100)      Pages: 1 - 50 - 100 | » Next

Browse Input Devices			Sort by: Relevance
Product Name	Partner Name	Description	
→ Intuos2 Graphics Tablet (Hardware)	Wacom Technology Corp.	The Intuos2 series tablet's transparent overlay and programmable menu strip, provide the right balance of professional, features, functionality and size to meet the needs of creative.	Product Certification Partner Name
→ Product Name (Hardware)	Partner Name	The Intuos2 series tablets, with their transparent overlay and programmable menu strip, provide the right balance of.	
→ Product Name (Hardware)	Partner Name	The Intuos2 series tablets, with their transparent overlay and programmable menu strip, provide the right balance of.	

Headline

Subhead

Body copy lorem ipsum dolor sit amet, consectetur > More

# Sun Microsystems

The browse filters continue to change out and provide a new set of options. This process continues until the user reaches a "leaf" results page.

Notice that the breadcrumb grows, and will continue to grow as the search continues.

The screenshot shows the Sun Microsystems website interface. At the top, there is a navigation bar with links for 'How to Buy', 'My Sun', and 'Worldwide Sites', along with a search box. Below this is a main header with 'Products & Services' and 'Support & Training' buttons. A breadcrumb trail reads: 'Home > iForce > Partner Directory > Products > Product Type > Hardware > Peripherals >'. The main heading is 'Input Devices', with a sub-filter 'Only In: Healthcare, Sold In'. There are three tabs: 'Find a Partner', 'Find a Product', and 'Find a Solution'. Below the tabs, there are filter options for 'Application Area', 'Sun Technologies', and 'Location'. The 'Location' filter is expanded, showing options like Africa (5), Asia (40), Europe (48), North America (48), etc. A search box is present with a dropdown menu showing 'Entire Directory', '- Within Products', '---- Within Input Devices (All)', and '---- Within Input Devices (Filtered)'. Below the search box is an 'Advanced Search' link. On the right side, there is a 'Global Partner Directory' section with links for 'Contact Sun', 'Welcome, (User Name)', 'Edit Account', 'Log Out', 'Edit Partner Directory Information', and 'How to Use this Directory'. At the bottom, there is a table titled 'Browse Input Devices' with columns for 'Product Name', 'Partner Name', and 'Description'. The table is sorted by 'Relevance'. The first row shows 'Intuos2 Graphics Tablet (Hardware)' by 'Wacom Technology Corp.' with a 'Solaris Ready' certification. The second and third rows show generic 'Product Name (Hardware)' entries with 'Partner Name' and 'Solaris Ready' certification. A 'Headline' section is visible on the right side of the page, featuring an image of a person using a tablet and the text 'Headline', 'Subhead', and 'Body copy lorem ipsum dolor sit amet, consectetur > More'.

sun.com      How to Buy | My Sun | Worldwide Sites      Search >>

→ Products & Services      → Support & Training

Home > iForce > Partner Directory > Products > Product Type > Hardware > Peripherals >

## Input Devices

Only In: Healthcare, Sold In

Find a Partner    Find a Product    Find a Solution

Filter results by: Application Area | Sun Technologies | Location    Hide Browse Filters

» Africa (5)      » Asia (40)      » Europe (48)      » South America (15)  
 » Antarctica (2)      » Australia (42)      » North America (48)

Search:     Entire Directory  
 - Within Products  
 ---- Within Input Devices (All)  
 ---- Within Input Devices (Filtered) >>

» Advanced Search

Global Partner Directory

» Contact Sun

Welcome, (User Name)

» Edit Account  
 » Log Out

» Edit Partner Directory Information

» How to Use this Directory

Page 1 (1-50 of 50)

Browse Input Devices		Sort by: Relevance >>
Product Name	Partner Name	Description
→ Intuos2 Graphics Tablet (Hardware)	Wacom Technology Corp.	The Intuos2 series tablet provides a transparent overlay and programmable menu strip, provide the right balance of professional features, functionality and size to meet the needs of creative. <b>Certification: Solaris Ready</b>
→ Product Name (Hardware)	Partner Name	The Intuos2 series tablets, with their transparent overlay and programmable menu strip, provide the right balance of. <b>Certification: Solaris Ready</b>
→ Product Name (Hardware)	Partner Name	The Intuos2 series tablets, with their transparent overlay and programmable menu strip, provide the right balance of. <b>Certification: Solaris Ready</b>

Headline

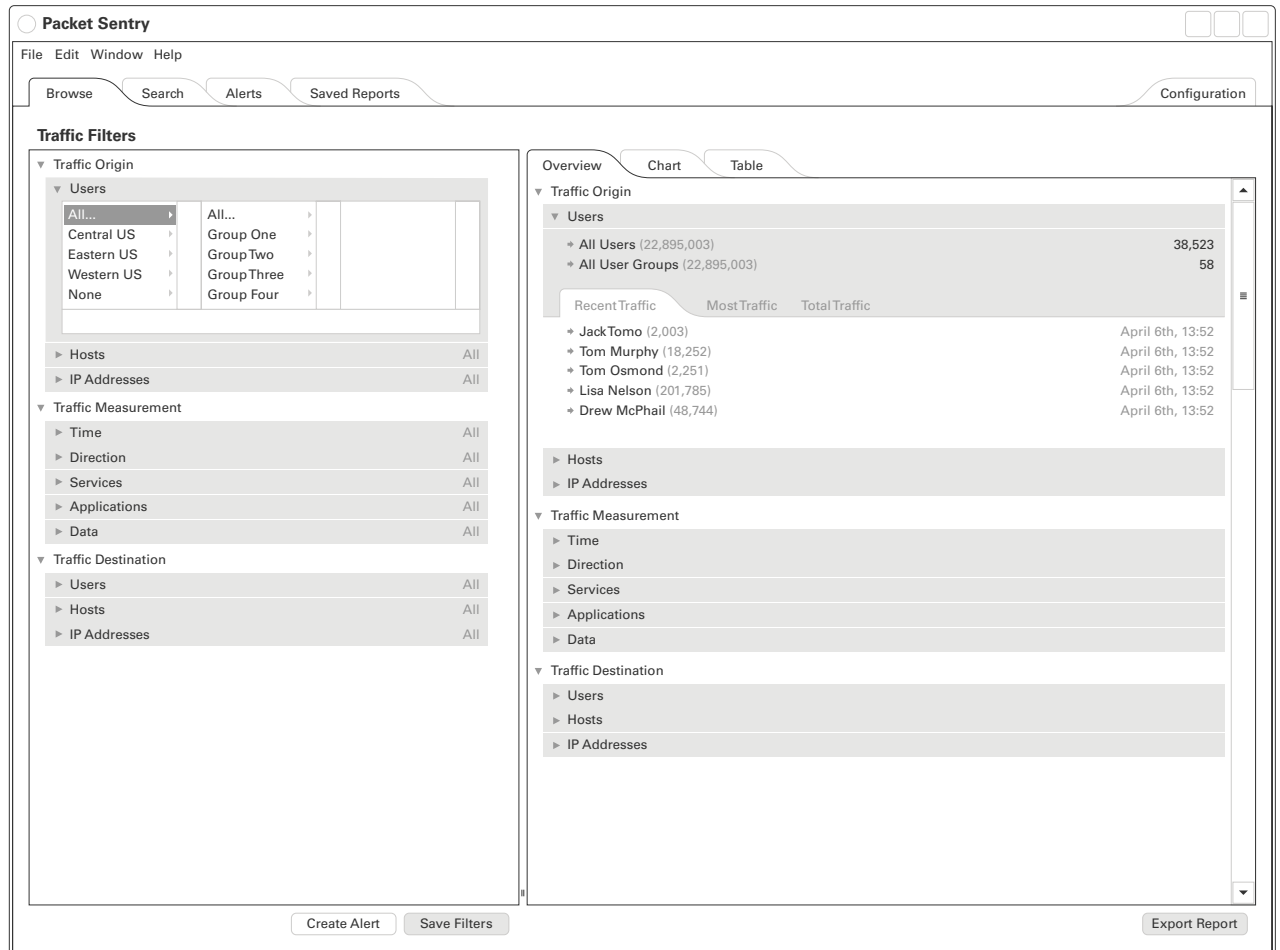
Subhead

Body copy lorem ipsum dolor sit amet, consectetur > More

# PacketMotion

In 2006, Greg Baker designed an interface that for PacketMotion, a company which provides multi-dimensional visibility into network activity to allow for better control and security over an enterprise. The interface covers 11 dimensions, which are grouped under 3 sections: Traffic Origin, Traffic Measurement, and Traffic Destination.

First, the user selects the Traffic Origin section, then the Users dimension, and stops at All users. The results section, on the right, returns more detailed information.





# PacketMotion

Next, the user selects the Traffic Destination section, then the Host dimension, and continues refining their input down to a specific host machine. Again, The overview section updates to reveal more details.

The screenshot shows the Packet Sentry interface with the following components:

- Navigation:** File, Edit, Window, Help menus; Browse, Search, Alerts, Saved Reports tabs; Configuration button.
- Traffic Filters:**
  - Traffic Origin:** Users (All..., Central US, Eastern US, Western US, None), Hosts (All), IP Addresses (All).
  - Traffic Measurement:** Time (All), Direction (All), Services (All), Applications (All), Data (All).
  - Traffic Destination:** Users (All), Hosts (All..., Central US, Eastern US, Western US, None), IP Addresses (All).
- Overview:**
  - Traffic Origin:** Users (Filtered Users: 10,012; Filtered User Groups: 10,012).
  - Recent Traffic:**

User	Count	Time
Jack Tomo	2,003	April 6th, 13:52
Tom Murphy	18,252	April 6th, 13:52
Tom Osmond	2,251	April 6th, 13:52
Lisa Nelson	201,785	April 6th, 13:52
Drew McPhail	48,744	April 6th, 13:52
  - Traffic Measurement:** Time, Direction, Services, Applications, Data.
  - Traffic Destination:** Users, Hosts (finance serv\_01: 1,003).
  - Recent Users:**

User	Count	Time
Jack Tomo	2,003	April 6th, 13:48
Tom Murphy	18,252	April 6th, 13:47
Tom Osmond	2,251	April 6th, 13:47
Lisa Nelson	201,785	April 6th, 13:46
Drew McPhail	48,744	April 6th, 13:45
- Actions:** Create Alert, Save Filters, Export Report buttons.

# PacketMotion

Then, the user selects the last section of Traffic Measurement, then the time dimension, and specifies Last Week. Notice that the total results returned (in the top right of the users overview) have been narrowed down from 38,523 to 16.

The screenshot displays the Packet Sentry web interface. The left pane, titled "Traffic Filters", shows a tree view of filter categories. Under "Traffic Origin", the "Users" filter is expanded, showing a grid of filters for location (Central US, Eastern US, Western US, None) and department (Engineering, Executive, Finance, HR). The "Last Week" filter is selected under "Time". Other filters for Hosts, IP Addresses, Direction, Services, Applications, and Data are shown as "Filtered". Under "Traffic Destination", the "Users" filter is set to "None" and "Hosts" are expanded to show a grid of service filters (finance\_serv\_01 to finance\_serv\_04).

The right pane, titled "Overview", shows the results of the filters. Under "Traffic Origin", the "Users" filter is expanded, showing a list of filtered users and user groups:

User	Count	Time
Filtered Users	8,013	
Filtered User Groups	8,013	
Jack Tomo	2,003	April 6th, 13:52
Tom Murphy	18,252	April 6th, 13:52
Tom Osmond	2,251	April 6th, 13:52
Lisa Nelson	201,785	April 6th, 13:52
Drew McPhail	48,744	April 6th, 13:52

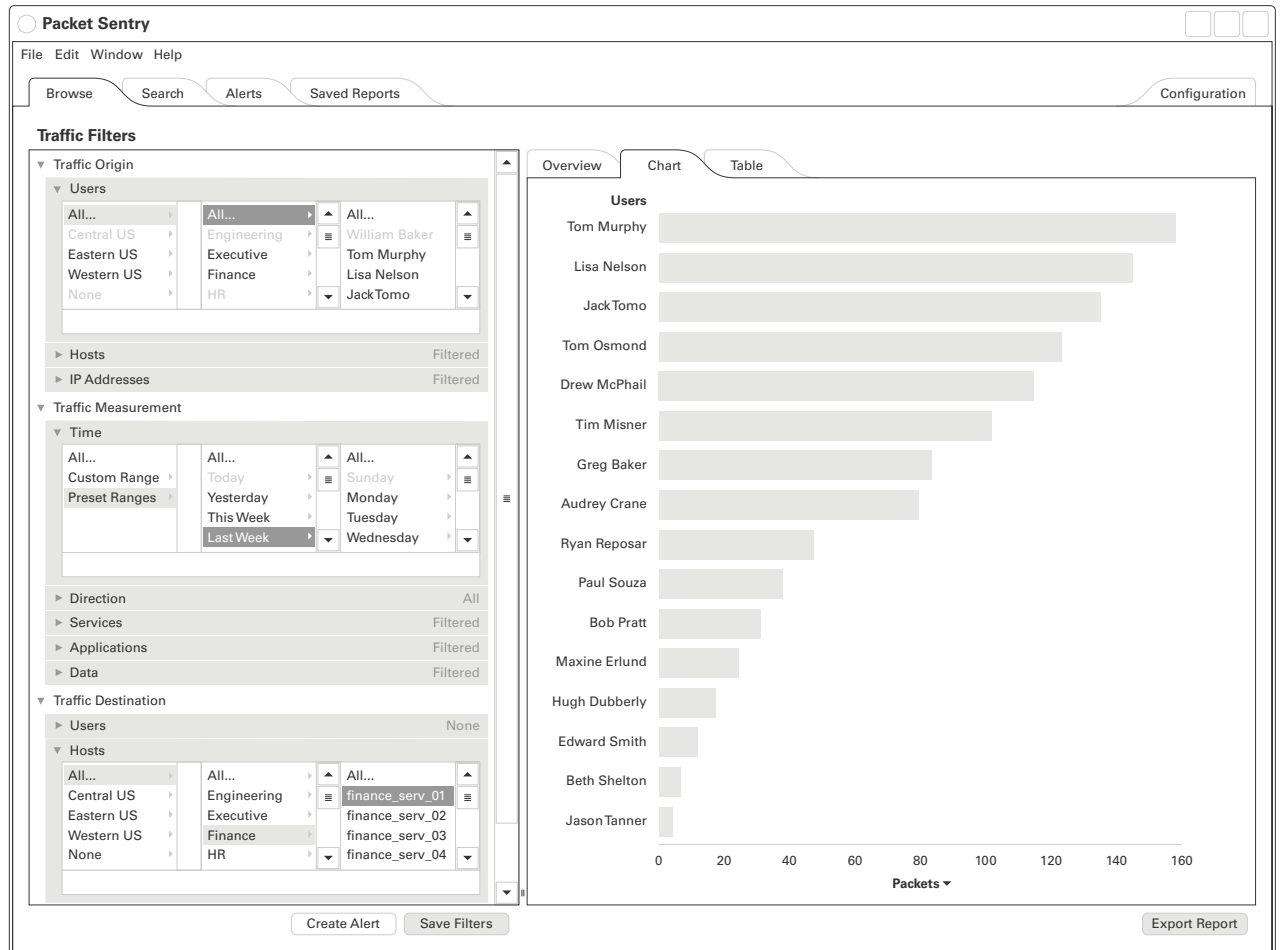
Under "Traffic Measurement", the "Time" filter is expanded, showing a list of filtered times:

Time	Count
Filtered Last Week	2,018
April 6th, 13:48	48
April 6th, 13:48	103
April 6th, 13:47	210
April 6th, 13:46	142
April 6th, 13:42	8

Buttons for "Create Alert", "Save Filters", and "Export Report" are visible at the bottom of the interface.

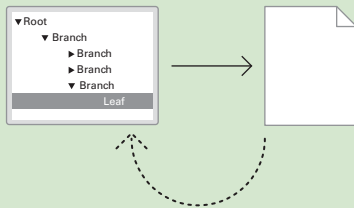
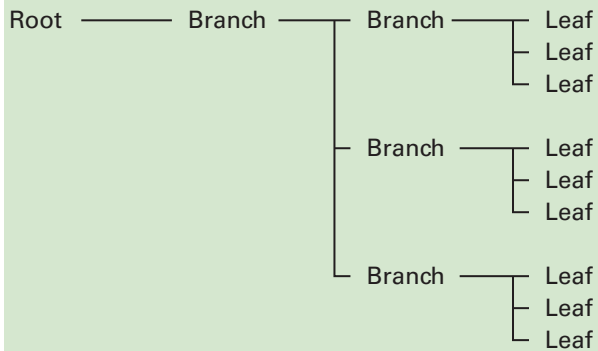
# PacketMotion

Finally, with all the traffic filters specified, the user switches from the overview tab to the chart tab to see a different view of their desired information.



# Summary of Navigation Structures

## Browse a Tree



### Pros:

- Direct control
- May show full data set
- User sees scope and location

### Cons:

- Doesn't scale
- Becomes unwieldy over ~400 items

## Search a Database



Can be like looking at a database through a keyhole.



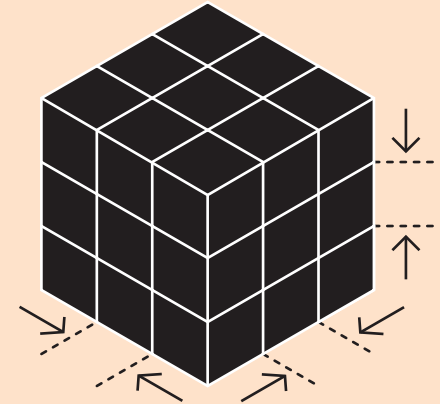
### Pros:

- Works better for large data sets
- Great if you know the data set
- Can be fast, direct

### Cons:

- Can't see full scope of data
- May swamp users with too many results

## Filter a Database



### Pros:

- Allows exploration of large data sets
- Can be combined with browse and search

### Cons:

- Less familiar to many users
- Requires highly structured data